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PRACTICE WITH SCIENCE.

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1873.

THESE EXPERIMENTS, IT IS TRUE, ARE NOT EASY; STILL THEY ARE IN THE POWER OF EVERY THINKING HUSBANDMAN. HE WHO ACCOMPLISHES BUT ONE, OF HOWEVER LIMITED APPLICATION, AND TAKES CARE TO REPORT IT FAITHFULLY, ADVANCES THE SCIENCE, AND, CONSEQUENTLY, THE PRACTICE OF AGRICULTURE, AND ACQUIRES THEREBY A RIGHT TO THE GRATITUDE OF HIS FELLOWS, AND OF THOSE WHO COME AFTER. TO MAKE MANY SUCH IS BEYOND THE POWER OF MOST INDIVIDUALS, AND CANNOT BE EXPECTED. THE FIRST CARE OF ALL SOCIETIES FORMED FOR THE IMPROVEMENT OF OUR SCIENCE SHOULD BE TO PREPARE THE FORMS OF SUCH EXPERIMENTS, AND TO DISTRIBUTE THE EXECUTION OF THESE AMONG THEIR MEMBERS.

VAN THAER, *Principles of Agriculture.*

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The Binder is desired to collect together all the Appendix matter, with Roman numeral folios, and place it at the *end* of each volume of the Journal, excepting Titles and Contents, and Statistics, &c., which are in all cases to be placed at the *beginning* of the Volume; the lettering at the back to include a statement of the *year* as well as the *volume;* the first volume belonging to 1839–40, the second to 1841, the third to 1842, the fourth to 1843, and so on.

In Reprints of the Journal all Appendix matter and, in one instance, an Article in the body of the Journal (which at the time had become obsolete), were omitted; the Roman numeral folios, however (for convenience of reference), were reprinted without alteration in the Appendix matter retained.

METEOROLOGY; IMPORTATIONS OF GRAIN; SALES OF BRITISH WHEAT; PRICES OF CORN AND OTHER PRODUCE; AGRICULTURAL STATISTICS; AND STATISTICS OF DAIRY PRODUCE.

[*The facts are derived chiefly from the Meteorological Reports of* Mr. Glaisher, *and the Returns of the* Board of Trade, *and of the* Inspector-General of Imports and Exports.]

METEOROLOGY.—1872.

First Quarter (January, February, March).—The warm weather which set in on December 13th, 1871, continued with very few exceptions till the 18th March—then followed eight days of severe cold weather, and snow fell over the country, even to the South Coast, and over the counties of Devonshire and Cornwall. This cold period was very severely felt, owing to its suddenness and great contrast to the long continued high temperature of the preceding ninety-seven days. The remaining five days of the quarter wero warm—and Mr. Glaisher states that he does not know any instance of so remarkable a cold period as that ending December 12th, 1871, being followed by as remarkable a warm one as that ending March 18th, 1872. The remarkable feature of the winter now under review is the long continuance of high temperature following immediately so remarkable a long continuance of weather of low temperature. For 100 years back, the warmth of the past three months has been but once equalled, viz., in 1846, and has never been exceeded. The mean temperature of January was 41°·3 or 5° higher than the average of 101 years; that of February was 44°·8 or 6°·3 higher than the average, and the mean temperature of March was 44°·6 or 3°·7 in excess of the average. The mean temperature in the three months ending February, constituting the three *winter* months, was 41°·5 or 3°·5 higher than the average of 101 years.

The fall of rain in February was only one half of its average, but in January and March it was in excess.

Hardy Pear was in blossom on the 9th of March at Llandudno; on the 11th at Helston; on the 20th at Chislehurst; on the 24th at Carlisle; on the 26th at Weybridge; on the 28th at Oxford and Culloden; on the 29th at Eastbourne; on the 30th at London; on the 31st at Strathfield Turgiss.

Hardy Apple was in blossom on the 20th of March at Helston; on the 30th at Oxford; on the 31st at Eastbourne.

Cherry was in blossom on the 14th of March at Brighton; on the 22nd at Oxford; and on the 31st at Carlisle.

Plum was in blossom on the 7th of March at Strathfield Turgiss; on the 12th at Helston; on the 13th at Oxford; on the 24th at Weybridge Heath; on the 28th at Culloden; and on the 31st at Carlisle.

Rooks began to build on the 22nd of March at Brighton.

Second Quarter (*April, May, June*).—The weather at the end of March and till the first week in May was very changeable, there were alternately a few days of warmth, and then a few days of cold, the warm periods preponderating both in duration and in excess of temperature over the defects of temperature and cold. Till May 5th the temperature was in excess to the amount of $2\frac{3}{4}°$ on the average daily. From the 6th of May to the 12th of June, with the exception of three or four days of moderate warm weather at the end of May, the weather was cold, the sky mostly cloudy, the nights of low temperature with hoar frost and frequent rain, the average deficiency of daily temperature was $3\frac{1}{2}°$. On June 13th a warm period set in, and for some days the weather was fine, bright, and hot, but towards the end of the month it was again changeable, there was an excess of daily temperature above these averages of $3\frac{3}{4}°$. Some heavy thunderstorms took place during the hot weather in June 17th, 18th, and 19th, principally over the Northern and Midland Counties.

The changeable weather which had thus prevailed nearly throughout the quarter, sometimes warm but frequently cold, till the middle of June, caused all cereal crops to be in a backward state, as they did not receive sufficient warmth and sunshine; their forward state in the early spring was entirely lost through the low temperature and harsh weather in the month of May. Under the influence of the bright sunshine and hot weather about the middle of June, everything progressed satisfactorily and rapidly; at the end of the quarter vegetation generally was about ten or twelve days later than in an average season. The wheat crop was generally in ear or in bloom. The storms in June had, in some places, laid the wheat, and in others, blown off the blossoms, but only in a small portion of the whole, and it was generally expected the yield would be that of a full average.

The hay crop was spoken of as generally very good, and the heaviest for many years.

The potato crop was also spoken of as good and abundant, but subsequently suffered to an unusual extent from the well-known potato-disease.

The average temperature of these three months differs less than ¼ of a degree from the average of the same months in the preceding 30 years.

The mean temperature of April, May, and June, was 48°·3, 50°·9, and 59°·2 respectively; that of April was 2°·3, and that of June 1°·0 higher than the average; while that of May was 1°·7 lower than the average. The mean temperature of the air in the three months ending May, constituting the three *spring* months, was 47°·9 or 1°·4 higher than the average of 101 years. The fall of rain was 0·7 inch and 0·3 inch, respectively, in defect of the average in April and June, but 0·9 inch in excess in May.

Wheat was in ear on the 17th of June at Cardington; on the 19th at Hull; on the 20th at Llandudno; on the 21st at Helston, Hawarden, and Cockermouth. *In flower* on the 20th of June at Chislehurst; on the 21st at Silloth; on the 24th at Taunton and Weybridge; on the 27th at Cardington; on the 28th at Hawarden; and on the 30th at Helston.

Barley was in flower on the 20th of June at Llandudno.

Rye was in flower on the 7th of June at Chislehurst.

Oats were in flower on the 30th of June at Weybridge.

Third Quarter (*July*, *August*, *September*). The weather during the whole quarter was changeable. The mean temperature in July, notwithstanding a cold period which lasted from the 8th to the 18th, was 3°·4 above the average, the warmest period in the whole quarter being the eleven days from the 19th to the 29th July, during which the average daily excess of temperature was 7°·9. The first half of August was cold and wet, but during the latter part of that month and the early part of September the temperature was higher, though the weather was unsettled. From the 17th September to the end of the quarter, rain fell generally and the daily temperature was deficient. The most remarkable feature of the quarter was the frequency of thunderstorms.

The mean temperature of July was 65°·0, or 3°·4 higher than the average of 101 years, that of August was 61°·0 or 0°·2 higher than the average, and that of September was 57°·4 or 0°·9 higher than the average. The mean temperature in the three months ending

August, constituting the three *summer* months, was 61°·7 or 1°·5 higher than the average. The fall of rain was 0·1 inch and 1·0 inch, respectively, in defect in July and September, but 0·3 inch in excess in August.

Wheat was in flower on the 1st of July at Helston; and on the 12th at Culloden.—*Wheat* was *cut* on the 27th of July at Royston; on the 29th at Osborne, Chislehurst, and Cardington; on the 30th at Brighton and Oxford. On the 1st of August at Guernsey; on the 4th at Weybridge; on the 10th at Helston; on the 12th at Llandudno; on the 19th at Carlisle; on the 25th at Milltown; and on the 28th at North Shields. On the 14th of September at Silloth.

Barley was in flower on the 10th of July at Culloden.—*In ear* on the 2nd of July at Helston.—*Cut* on the 2nd of August, at Weybridge; on the 6th at Llandudno; on the 10th at Guernsey; and on the 12th at Helston and Carlisle.

Rye was cut on the 13th of July at Brighton and Chislehurst. On the 26th of August at Culloden.

Oats were in flower on the 5th of July at Culloden.—*In ear* on the 2nd of July at Helston.—*Cut* on the 27th of July at Osborne; on the 28th at Helston; and on the 29th at Chislehurst and Oxford. On the 1st of August at Weybridge; on the 19th at Stonyhurst; on the 20th at Guernsey; and on the 30th at Milltown.

Peas were cut on the 27th of August at Culloden.

Flax was pulled on the 20th of August at Milltown.

Fourth Quarter (*October, November, December*).—Until the 24th October the weather was cold, but on the 25th a warm period set in and continued till November 9th. From November 10th to the 19th was a steady cold period, but from November 20th to December 3rd the weather was warm. Then followed a period of changeable weather which lasted up to December 19th. On the 20th an extraordinary warm period set in, and continued to the end of the year.

The mean temperature of October was 47°·8, being 1°·8 lower than the average of 101 years; that of November was 45°·3, or 3°.0 higher than the average, and that of December was 42°·9, or 3°·8 higher than the average. The mean temperature in the three months ending November, constituting the three *autumn* months, was 50°·2, or 0°·7 higher than the average. The fall of rain was 1·5 in. 0·6 in., and 2·1 in. in excess of the average in October, November, and December, respectively.

The readings of the barometer at 159 feet above the sea-level were remarkably low throughout the quarter, the mean values for each month were :—October 29·533 in., November 29·511 in., and

December 29·413 in., and these departures below the averages were 0·172 in., 0·252, and 0·397 respectively. It is very rarely that such a long period of continuous depression is experienced.

The most remarkable feature, however, has been the frequency of rain. During the quarter it has fallen at Greenwich on 67 days, a greater number than has been previously experienced at Greenwich back to the year 1815. The total fall was large, amounting to 11·32 inches. The previous instances of large falls at Greenwich are as follows:—

Year.	Amount Fallen.			Total Fall in the Quarter.	Number of Days of Rain in			The Quarter.
	October.	November.	December.		Oct.	Nov.	Dec.	
	in.	in.	in.	in.				
1821	2·42	4·33	4·72	11·47	11	20	19	50
1822	3·60	3·66	2·26	9·52	12	16	6	34
1824	2·44	3·88	3·55	9·87	12	14	17	43
1831	3·65	2·70	3·47	9·82	19	15	19	53
1832	4·41	4·48	2·08	10·97	16	15	16	47
1833	2·87	2·51	4·95	10·33	13	11	27	51
1841	5·84	2·75	1·92	10·51	22	13	18	53
1844	4·01	4·74	0·34	9·09	15	13	6	34
1852	3·75	5·66	1·72	11·13	15	22	19	56
1865	5·90	2·39	0·87	9·16	19	18	10	47
1868	2·59	1·16	5·45	9·20	13	12	23	48
1872	4·33	2·92	4·07	11·32	22	24	21	67

The Table shows that the total fall in the quarter has been but once exceeded, viz., in the year 1821, when it was 11·47 inches or 0·15 greater; back to 1818, there is only one other instance of a fall exceeding 11 inches, viz., in 1852. The Table also shows that in 58 years there have been 12 instances of the fall in the three months ending December exceeding 9 inches, of which five were between 9 and 10; three between 10 and 11, and three exceeding 11 inches. The number of days of rain are shown in the last column, they differ greatly, and all are less in number than in the quarter just closed. This unusual frequency of rain has been general over the country. At Stonyhurst, in Lancashire, rain fell on every day in the quarter except two, and at Guernsey on 80 days, and the general average over the country was 67 days. The amount at Guernsey is very remarkable, being as large as 25¼ inches. The average fall of rain from all stations was 13·97 inches, being more than double of the fall in the corresponding period of the year 1871, which was 6·09 inches. The smallest falls of rain at Greenwich in this quarter were in 1851, when it was 2·92 inches, and in 1871 when it was 3·17 inches, in both cases preceding the two heaviest falls.

The Agricultural prospects towards the close of the quarter are thus described in the *Mark Lane Express* for 23rd December.—"The state of the weather has become the permanent source of complaint. The floods, instead of abating, have further increased, and most of our great rivers have overflown their banks, entirely swamping the low-lying neighbourhoods. Farmers are literally puzzled what to do, their horses getting out of health, for want of work, in the stables, the land hopelessly sodden, and the flail or thrashing machine next to useless; while round our coasts there have been numerous and terrible wrecks. But it is almost dangerous to have a strong frost when vegetation is so heavily charged with moisture, and all we can hope for is a continuance of moderate breezes till the land is in working order. There are many fears that the little wheat already planted will turn out a partial failure, the seed rotting in the soil; and this apprehension is felt on the continent of Europe, where the sowing was more successful, as well as here. Still, with foreign supplies arriving in greater plenty than what immediate consumption requires, the market is effectually prevented from rising, and is only maintained with difficulty. It is worthy of note that for the last four weeks the London averages have been below those of the country about 1*s*. per qr., and this may well account for the poor supplies sent up to the metropolis. Farmers, indeed, would seem to send very little more here than what they are obliged, and of the poorest quality, London being the great market for everything good or bad. We are not fond of disparaging our own produce, but it is clear from the exhibition of samples, that if no rain had fallen, the crop in quality, more especially the white wheat, would have been below the average of seasons; and if we select the numerous sprouted corns from these we shall find they were the best and plumpest grains, which are always the first to grow. The damage therefore to the flour is unusually great, its strength and nutrition are diminished, and though only a slow and gradual course will make this felt, it shows that whatever be the present dulness or the fluctuations following, we must have unusual imports to fill the void. Paris is again 1 fr. dearer for flour, Belgium and Holland show a slight improvement, but Dantzic has rather given way, other places remaining much the same. They have frost at Königsberg, Dantzic, and Stettin."

TABLE showing the RAINFALL in DIFFERENT PARTS of ENGLAND and WALES from Information supplied by MEMBERS of the COUNCIL of the ROYAL AGRICULTURAL SOCIETY of ENGLAND.

STATIONS.	Authority.	1872.	1871.	Average.		Excess of Rainfall in the Year 1872 over the Average.
		Inches.	Inches.	Inches.	Years.	Inches.
Hawkstone, near Shrewsbury (Salop) ..	Viscount Hill	47·66	30·56	..	..	..
Fitz Manor, Shrewsbury (Salop)	Mr. R. Middleton, per Mr. J. Bowen Jones	41·07	24·22	22·82	1866-71 inclusive	18·25
Lansdowne, Evesham (Worcestershire)	Mr. R. Burlingham, per Mr. C. Randell	37·89*	25·23	24·97	1866-71 ,,	12·92
Holkham (Norfolk)	Earl of Leicester	33·44	22·27	24·75	1849-71 ,,	8·69
Holker, Carke in Cartmel, Carnforth (Lancashire)	Duke of Devonshire	61·87	42·41	43·86	1868-71 ,,	18·01
Falmer, near Lewes (Sussex	Mr. R. R. Verrall, per Earl of Chichester	42·50	28·39	33·76	1860-71 ,,	8·74
Stanmer Park, near Lewes (Sussex) ..	Earl of Chichester	46·75†	..	..	..	..
Maidstone (Kent)	Mr. C. Whitehead	39·51	..	..	..	..
Riding Court, Datchet (Bucks)	Mr. C. S. Cautrell	35·00	20·00	24·16	1870-1 ,,	10·84
Ribston, Wetherby (Yorkshire)	Mr. J. D. Dent, M.P.	43·07	30·36	25·64	1864-71 ,,	17·43
Shotley Hall (Northumberland)	Mr. T. Wilson, per Mr. Jacob Wilson	48·03‡	26·90	27·73	1859-71 ,,	20·30
Denton, 4 miles west of Grantham (Lincolnshire)	Mr. W. Earle Welby, M.P. ..	30·34	21·90	21·32	1869-71 ,,	9·02
Peterborough (Northamptonshire)	Rev. G. Heathcote, per Mr. W. Wells, M.P.	31·15	19·82	18·73	1869-71 ,,	12·42
Harston (Leicestershire)	Mr. C. Beasley, per Mr. W. Earle Welby, M.P.	35·81§	..	..	..	..
Belvoir Castle (Leicestershire)	Duke of Rutland	35·45	23·54	23·82	1855-71 ,,	11·63
Cricket St. Thomas (Somersetshire) ..	Viscount Bridport	59·56	40·37	39·39	1868-71 ,,	20·17
Ruabon (Denbighshire, N.W.)	Sir Watkin W. Wynn, Bart., M.P.	60·44‖	37·33	34·95	1868-71 ,,	25·49
Brynkynalt, Chirk (Denbighshire, N.W.)	Lord Hill Trevor, per Sir Watkin W. Wynn, Bart., M.P.	62·60	..	..	..	..

* Rain fell on 185 days. † Rain fell on 166 days. ‡ Rain fell on 183 days. § Rain fell on 220 days. ‖ Rain fell on 290 days.

METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE FIRST SIX MONTHS OF THE YEAR 1872.

1872. MONTHS.	Temperature of Air. Mean.	Air. Diff. from average of 101 years.	Air. Diff. from average of 31 years.	Evaporation. Mean.	Evaporation. Diff. from average of 31 years.	Dew Point. Mean.	Dew Point. Diff. from average of 31 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 31 years.	Water of the Thames.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 31 years.	Weight of vapour in a Cubic Foot of Air. Mean.	Weight of vapour in a Cubic Foot of Air. Diff. from average of 31 years.
	°	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
January ..	41·3	+5·0	+3·3	39·9	+2·2	38·1	+3·4	9·3	−0·3	40·1	0·230	+0·029	2·7	+0·4
February	44·8	+6·3	+5·5	42·9	+5·3	40·7	+5·7	12·5	+1·1	44·2	0·254	+0·048	2·9	+0·5
March ..	44·6	+3·7	+3·1	42·4	+3·2	39·8	+3·6	15·8	+1·2	46·5	0·245	+0·030	2·8	+0·3
Mean ..	43·6	+5·0	+4·0	41·7	+3·6	39·5	+4·2	12·5	+0·7	43·6	0·243	+0·036	2·8	+0·4
	°	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
April	48·3	+2·3	+1·2	44·8	+0·7	41·0	+0·3	19·3	+0·7	50·7	0·257	+0·003	2·9	0·0
May	50·9	−1·7	−2·1	47·3	−1·9	43·6	−1·9	19·7	−0·8	54·5	0·284	−0·019	3·3	−0·1
June	59·2	+1·0	+0·2	54·9	+0·3	51·1	+0·4	21·3	+0·2	61·9	0·375	+0·005	4·2	+0·1
Mean ..	52·8	+0·5	−0·2	49·0	−0·3	45·2	−0·4	20·1	0·0	55·7	0·305	−0·004	3·5	0·0

NOTE.—In reading this Table it will be borne in mind that the sign (−) *minus* signifies *below* the average, and that the sign (+) *plus* signifies *above* the average.

METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE FIRST SIX MONTHS OF THE YEAR 1872.

1872. MONTHS.	Degree of Humidity.		Reading of Barometer.		Weight of a Cubic Foot of Air.		Rain.		Daily Horizontal movement of the Air.	Reading of Thermometer on Grass.				
										Number of Nights it was				
	Mean.	Diff. from average of 31 years.	Mean.	Diff. from average of 31 years.	Mean.	Diff. from average of 31 years.	Amount.	Diff. from average of 57 years.		At or below 30°.	Between 30° and 40°.	Above 40°.	Lowest Reading at Night.	Highest Reading at Night.
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
January ..	89	+ 1	29·463	−0·286	545	− 9	3·6	+1·7	325	11	19	1	20·1	40·2
February ..	86	+ 1	29·645	−0·152	544	− 9	0·8	−0·8	302	6	21	2	24·2	42·4
March ..	84	+ 2	29·625	−0·125	544	− 6	2·1	+0·5	276	14	11	6	19·9	46·7
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Mean ..	86	+ 1	29·578	−0·188	544	− 8	6·5	+1·4	301	31	51	9	19·9	46·7
			in.	in.	grs.	grs.	in.	in.	Miles				°	°
April	76	− 3	29·735	−0·034	542	− 1	1·0	−0·7	273	8	19	3	21·3	45·2
May	76	0	29·736	−0·045	539	− 2	3·1	+0·9	257	5	15	11	25·8	47·4
June	75	+ 1	29·735	−0·081	530	− 2	1·6	−0·3	264	1	8	21	28·5	54·8
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Mean ..	76	− 1	29·735	−0·053	537	− 2	5·7	0·0	265	14	42	35	21·3	54·8

NOTE.—In reading this Table it will be borne in mind that the sign (−) *minus* signifies *below* the average, and that the sign (+) *plus* signifies *above* the average.

Meteorological Observations recorded at the Royal Observatory, Greenwich, in the Last Six Months of the Year 1872.

1872. Months.	Temperature of Air. Mean.	Air. Diff. from average of 101 years.	Air. Diff. from average of 31 years.	Evaporation. Mean.	Evaporation. Diff. from average of 31 years.	Dew Point. Mean.	Dew Point. Diff. from average of 31 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 31 years.	Water of the Thames.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 31 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour in a Cubic Foot of Air. Diff. from average of 31 years.
	°	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
July	65·0	+3·4	+3·0	60·9	+3·4	57·5	+3·7	23·4	+2·4	67·4	0·473	+0·058	5·3	+0·7
August ..	61·0	+0·2	−0·4	56·5	−0·8	53·6	−0·1	20·4	+0·6	65·5	0·412	−0·004	4·5	−0·1
September ..	57·4	+0·9	+0·1	54·0	−0·1	50·8	−0·3	19·1	+0·6	62·0	0·371	−0·009	4·2	0·0
Mean	61·1	+1·5	+0·9	57·1	+0·8	54·0	+1·1	21·0	+1·2	65·0	0·319	+0·015	4·7	+0·2
	°	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
October ..	47·8	−1·8	−2·5	46·5	−1·8	45·0	−1·2	15·6	+0·8	51·0	0·299	−0·015	3·4	−0·3
November ..	45·3	+3·0	+1·7	43·6	+2·3	41·7	+2·2	10·0	−1·7	46·0	0·264	+0·017	3·1	+0·3
December ..	42·9	+3·8	+2·7	41·4	+2·7	39·7	+2·8	8·3	−1·2	41·5	0·244	+0·023	2·8	+0·2
Mean ..	45·3	+1·7	+0·6	43·8	+1·1	42·1	+1·3	11·3	−0·7	46·2	0·269	+0·008	3·1	+0·1

NOTE.—In reading this Table it will be borne in mind that the sign (−) *minus* signifies *below* the average, and that the sign (+) *plus* signifies *above* the average.

METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE LAST SIX MONTHS OF THE YEAR 1872.

1872. MONTHS.	Degree of Humidity.		Reading of Barometer.		Weight of a Cubic Foot of Air.		Rain.		Daily Horizontal movement of the Air.	Reading of Thermometer on Grass.				
										Number of Nights it was			Lowest Reading at Night.	Highest Reading at Night.
	Mean.	Diff. from average of 31 years.	Mean.	Diff. from average of 31 years.	Mean.	Diff. from average of 31 years.	Amount.	Diff. from average of 57 years.		At or below 30°.	Between 30° and 40°.	Above 40°.		
			in.	in.	grs.	grs.	in.	in.	Miles				°	°
July	78	+ 3	29·759	−0.044	524	− 4	2·4	−0·1	185	0	3	28	38·1	60·1
August ..	75	− 1	29·800	+0·008	529	0	2·7	+0·3	224	0	3	28	35·9	54·2
September	79	− 1	29·681	−0·130	531	− 2	1·4	−1·0	319	4	9	17	26·0	57·9
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Mean	77	0	29·747	−0·055	528	− 2	6·5	−0·8	243	4	15	73	26·0	60·1
			in.	in.	grs.	grs.	in.	in.	Miles				°	°
October ..	91	+ 4	29·533	−0·171	539	0	4·3	+1·5	234	10	14	7	25·4	49·0
November ..	87	− 1	29·511	−0·252	541	− 1	2·9	+0·6	416	6	19	5	26·8	46·2
December ..	88	0	29·413	−0·397	542	−10	4·1	+2·1	346	8	19	4	17·9	43·0
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Mean ..	89	+ 1	29·486	−0·273	541	− 4	11·3	+4·2	332	24	52	16	17·9	49·0

NOTE.—In reading this Table it will be borne in mind that the sign (−) *minus* signifies *below* the average, and that the sign (+) *plus* signifies *above* the average.

Rainfall, at different Stations, in each of the Three Months ending 31st December, 1871 and 1872.

Names of Stations.	Rainfall in the 3 Months ending			
	31st December, 1871.		31st December, 1872.	
	Number of Days on which Rain fell.	Amount of Rain Collected.	Number of days on which Rain fell.	Amount of Rain Collected.
		Inches.		Inches.
Guernsey	45	9·73	80	25·24
Helston	51	11·95	70	17·85
Truro	48	10·33	77	17·76
Eastbourne	35	4·18	69	18·46
Osborne	35	4·61	67	16·34
Bournemouth	37	5·90	68	16·04
Portsmouth	35	4·75	71	14·52
Worthing	33	3·36	68	14·99
Brighton	35	3·13	75	15·90
Taunton	32	5·84	62	13·89
Wilton House	41	6·30	64	17·10
Barnstaple	58	10·45	78	19·36
Aldershot Camp	45	3·32	65	14·09
Strathfield Turgiss	33	3·12	66	11·32
Weybridge Heath	30	2·70	62	11·84
Marlborough College	42	4·99	68	16·40
Royal Observatory	39	3·17	67	11·32
Streatley Vicarage	34	2·94	62	11·77
Camden Town	35	2·95	63	13·53
Oxford	33	2·78	68	9·82
Gloucester	35	4·07	64	11·06
Royston	44	2·27	71	9·55
Cardington	33	2·34	56	9·71
Leamington	33	2·82	64	11·15
Somerleyton Rectory	43	5·43	69	11·47
Norwich	41	5·03	55	10·90
Wisbech	36	4·02	60	10·12
Llandudno	49	11·70	66	17·62
Derby	46	4·71	67	10·70
Nottingham	52	4·52	70	10·29
Hawarden	66	7·58	72	14·93
Liverpool	49	8·93	69	13·04
Eccles	51	8·18	73	10·83
Hull	51	5·40	63	11·00
Stonyhurst	78	12·55	89	14·79
Cockermouth	45	12·10	50	18·00
Allenheads	71	11·28	76	21.43
Silloth	46	9·74	51	12·54
Carlisle	55	2·80	57	9·19
North Shields	56	5·70	71	14·53
Milltown (Ireland)	51	5·57	60	14·28

CORN: Importations, Sales, and Prices.

Quantities of Wheat, Wheatmeal and Flour, Barley, Oats, Peas and Beans, Imported into the United Kingdom in the Year 1872.

1872.	Wheat.	Wheatmeal and Flour.	Barley.	Oats.	Peas.	Beans.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January ..	3,932,285	220,254	1,165,674	829,177	41,005	307,948
February	2,034,903	207,452	1,257,626	704,317	16,405	234,982
March ..	2,777,964	265,619	1,561,748	842,120	31,992	281,617
April ..	2,285,048	209,475	1,195,388	850,241	61,012	259,845
May ..	2,047,194	211,071	813,841	1,108,857	85,395	271,367
June ..	2,559,448	332,213	1,042,420	1,297,557	219,046	267,193
In first Six Months	15,636,842	1,446,084	7,036,697	5,632,269	454,855	1,622,952
July	3,997,257	315,374	748,494	1,375,422	122,743	199,706
August ..	3,526,112	300,499	562,421	912,670	125,220	189,641
September	4,237,694	356,169	811,654	835,627	91,298	235,328
October ..	5,718,647	636,199	1,762,645	1,270,609	200,369	286,749
November	4,949,083	625,970	1,835,833	579,434	114,511	172,137
December	3,924,593	715,764	2,320,396	961,027	181,080	231,001
In last Six Months	26,353,386	2,949,975	8,041,443	5,934,789	835,221	1,314,562
Year ..	41,990,228	4,396,059	15,078,140	11,567,058	1,290,076	2,937,514

Note.—The average weights *per quarter* of corn, as adopted in the office of the Inspector-General of Imports and Exports, are as follow:—For wheat, $485\frac{1}{3}$ lbs., or $4\frac{1}{3}$ cwts.; for barley, 400 lbs., or $3\frac{4}{7}$ cwts.; for oats, 308 lbs., or $2\frac{3}{4}$ cwts. Corn has been entered and charged with duty by *weight* instead of *measure* since September, 1864.

Computed Real Value of Corn Imported into the United Kingdom in each of the Five Years, 1868-72.

	1868.	1869.	1870.	1871.	1872.
	£.	£.	£.	£.	£.
Wheat	22,069,353	19,515,758	16,264,027	23,345,630	26,046,876
Barley	3,799,527	3,379,775	2,831,844	3,407,425	6,194,155
Oats	3,875,929	3,340,494	4,381,607	4,141,687	4,212,086
Maize	4,838,012	5,935,665	5,790,550	6,470,789	8,696,362
Other kinds	1,981,553	1,376,087	1,498,043	1,729,048	1,747,073
Wheat Flour	2,832,077	3,792,939	3,383,751	3,502,784	4,092,189
Other kinds of Flour	23,839	6,640	19,822	10,712	9,883
Total of Corn ..	39,420,290	37,347,358	34,169,644	42,403,575	50,998,624

QUANTITIES of BRITISH WHEAT SOLD in the Towns from which Returns are received under the Act of the 27th & 28th VICTORIA, cap. 87, and their AVERAGE PRICES, in each of the TWELVE MONTHS of the Years 1867-72.

	QUANTITIES IN QUARTERS.					
	1867.	1868.	1869.	1870.	1871.	1872.
	quarters.	quarters.	quarters.	quarters.	quarters.	quarters.
First month ..	221,791	193,077	248,047	187,027	267,827	194,719
Second month	203,900	201,325	258,883	231,428	309,376	193,910
Third month (five weeks)	280,878	235,402	278,086	314,040	377,003	245,612
Fourth month	205,231	173,120	204,519	242,457	293,494	191,522
Fifth month ..	221,067	162,030	238,483	281,620	222,003	231,780
Sixth month (five weeks)	196,985	128,142	268,599	296,028	229,749	268,626
Seventh month	109,829	106,812	166,485	171,005	120,154	109,543
Eighth month	102,303	174,633	174,904	201,788	123,889	126,769
Ninth month (five weeks)	265,668	444,296	255,286	435,398	371,590	295,774
Tenth month	349,788	284,810	256,984	340,445	367,672	264,934
Eleventh month	265,622	268,848	220,876	298,407	269,351	195,743
Twelfth month (five weeks)	301,558	307,386	244,933	352,629	322,756	263,152

	AVERAGE PRICES PER QUARTER.											
	1867.		1868.		1869.		1870.		1871.		1872.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
First month ..	61	5	70	4	51	10	43	11	52	8	55	4
Second month	60	11	72	11	50	10	41	10	53	6	55	8
Third month (five weeks)	59	9	73	1	48	5	41	3	54	6	55	1
Fourth month	61	7	73	4	46	4	42	7	58	2	54	2
Fifth month ..	64	8	74	3	44	8	43	10	59	1	56	3
Sixth month (five weeks)	65	5	68	9	45	10	47	0	59	8	58	11
Seventh month	65	1	65	6	49	5	50	9	58	7	58	7
Eighth month	68	0	57	9	52	1	53	11	57	11	59	9
Ninth month (five weeks)	63	5	55	1	51	4	47	0	57	0	58	7
Tenth month ..	66	7	53	11	47	8	47	4	56	5	58	7
Eleventh month	69	9	52	2	46	8	50	1	56	2	56	11
Twelfth month (five weeks)	67	7	50	2	44	2	52	4	56	2	56	7

Average Prices of British Corn per Quarter (imperial measure) as received from the Inspectors and Officers of Excise according to the Act of 27th & 28th Victoria, cap. 87, in each of the Fifty-two Weeks of the Year 1872.

Week ending	Wheat.		Barley.		Oats.		Week ending	Wheat.		Barley.		Oats.	
	s.	d.	s.	d.	s.	d.		s.	d.	s.	d.	s.	d.
January 6..	54	11	36	8	22	2	July 6 ..	58	4	32	3	24	5
January 13..	55	1	36	11	22	9	July 13 ..	58	4	33	3	23	9
January 20..	55	8	37	2	22	6	July 20 ..	58	6	32	1	24	5
January 27..	55	10	37	10	22	8	July 27 ..	59	1	32	1	24	9
February 3..	56	0	38	2	22	6	August 3 ..	59	5	36	4	25	2
February 10..	55	4	38	9	22	9	August 10 ..	59	5	30	8	25	1
February 17..	55	7	38	8	23	0	August 17 ..	59	10	30	3	23	7
February 24..	55	9	38	8	22	11	August 24 ..	60	3	32	8	26	7
March 2..	55	10	37	10	23	6	August 31 ..	59	6	31	3	25	2
March 9..	55	8	37	11	23	2	September 7	57	5	36	4	23	5
March 16..	55	5	37	7	22	11	September 14	58	0	35	10	23	5
March 23..	54	6	36	6	21	10	September 21	58	9	37	9	22	6
March 30..	54	2	37	0	22	1	September 28	59	2	39	5	22	9
Average of Winter Quarter	55	4	37	8	22	8	Average of Summer Quarter	58	11	33	10	24	2
April 6..	54	0	35	11	22	3	October 5 ..	58	10	40	1	22	4
April 13..	53	11	36	6	21	8	October 12 ..	58	9	41	9	23	2
April 20..	54	5	36	5	22	8	October 19 ..	58	8	42	11	23	1
April 27..	54	6	36	4	22	8	October 26 ..	57	11	43	10	23	0
May 4..	55	1	37	1	23	5	November 2	57	4	44	1	23	6
May 11..	56	0	36	7	22	10	November 9	56	9	43	3	22	4
May 18..	56	4	35	8	24	0	November 16	56	8	41	11	23	3
May 25..	57	9	35	5	23	8	November 23	56	9	42	1	22	1
June 1..	58	11	35	5	23	4	November 30	57	0	42	4	22	11
June 8..	59	1	35	10	22	11	December 7	57	0	42	6	22	11
June 15..	58	8	34	10	23	4	December 14	56	6	42	3	22	9
June 22..	59	0	33	0	24	2	December 21	56	3	41	2	23	2
June 29..	69	2	33	9	23	3	December 28	56	4	40	4	22	7
Average of Spring Quarter	56	8	35	7	23	1	Average of Autumn Quarter	57	3	42	2	22	10

Note.—The system of preparing the Monthly Trade Accounts of the United Kingdom has been altered since the commencement of the year 1871, with the view of providing earlier and more accurate information.

The quantities of articles imported are now taken from the "Importers' Entries," instead of from the "Landing Accounts," which are not completed until a much later date: the figures given for the Imports in January, 1871, will not, therefore, compare with those given for the months of January, 1869 and 1870—the former showing the complete Importations of the month, and the latter only the Returns of the Landing Accounts so far as received within the month, by which method the last seven to ten days' Importations of the month were excluded. So great a divergence will not occur in subsequent months.

The Import Account for the month of December, 1871, will in many cases exhibit a considerable deficiency when compared with the month of December in

QUANTITIES of WHEAT, BARLEY, OATS, PEAS, BEANS, INDIAN CORN or MAIZE, WHEATMEAL and FLOUR, IMPORTED in the THREE YEARS 1870-71-72; also the COUNTRIES from which the WHEAT, WHEATMEAL, and FLOUR were obtained.

	1870.	1871.	1872.
Wheat from—	cwts.	cwts.	cwts.
Russia	10,269,198	15,629,435	17,840,640
Denmark	327,919	130,370	431,176
Germany	3,348,214	3,049,031	3,887,746
France	253,644	134,841	2,843,016
Austrian Territories	60,472	239,147	54,732
Turkey and Wallachia and Moldavia	489,421	1,418,886	838,073
Egypt	104,950	884,396	2,337,208
United States	12,371,922	13,405,057	8,606,403
Chili	599,337	549,529	1,434,125
British North America	2,838,361	3,279,264	1,719,378
Other countries	237,791	687,690	1,997,731
Total Wheat	30,901,229	39,407,646	41,990,228
Barley	7,217,327	8,589,059	15,078,140
Oats	10,830,630	11,007,106	11,567,058
Peas	1,799,354	1,021,950	1,290,076
Beans	1,505,798	2,975,651	2,937,514
Indian Corn, or Maize	16,756,783	16,832,499	24,563,334
Wheatmeal and Flour from—			
Germany	911,108	967,892	1,054,574
France	645,181	37,150	1,341,465
United States	2,148,251	1,794,805	743,412
British North America	451,463	403,989	339,300
Other countries	647,906	780,802	917,308
Total Wheatmeal and Flour	4,803,909	3,984,638	4,396,059
Indian Corn Meal	5,741	7,881	5,384

previous years. This circumstance should not be taken to indicate a decrease in the trade of the month, inasmuch as in former years the account for December was not published until the end of the following February, and embraced the record of large quantities of goods imported in previous months, but not registered until the "Landing Accounts" had been received.

The Average Prices of Consols, of Wheat, of Meat, and of Potatoes; also the Average Number of Paupers relieved on the *last day* of each Week; and the Mean Temperature, in each of the Twelve Quarters ending December 31st, 1872.

Quarters ending	Average Prices.						Pauperism.		
	Consols (for Money).	Minimum Rate per Cent. of Discount charged by the Bank of England.	Wheat per Quarter in England and Wales.	Meat per lb. at the Metropolitan Meat Market (by the Carcase).		Potatoes (York Regents) per Ton, at Waterside Market, Southwark.	Quarterly Average of the Number of Paupers relieved on the *last day* of each week.		Mean Temperature.
				Beef.	Mutton.		In-door.	Out-door.	
1870	£.		*s.* *d.*						°
Mar. 31	92⅝	3·0	42 3	4½*d.*—7*d.* Mean 5¾*d.*	5¼*d.*—7¼*d.* Mean 6¼*d.*	95*s.*—110*s.* Mean 102*s.* 6*d.*	164,387	892,822	38·0
June 30	94	3·0	44 8	4½*d.*—6¾*d.* Mean 5⅝*d.*	5¼*d.*—7½*d.* Mean 6⅜*d.*	115*s.*—135*s.* Mean 125*s.*	144,226	825,337	54·4
Sept. 30	91 2/8	3·9	50 4	4¾*d.*—7¼*d.* Mean 6*d.*	5¼*d.*—8*d.* Mean 6⅝*d.*	100*s.*—140*s.* Mean 120*s.*	138,444	787,976	60·7
Dec. 31	92⅝	2·5	50 1	5*d.*—7¾*d.* Mean 6⅜*d.*	5¼*d.*—8*d.* Mean 6⅝*d.*	50*s.*—90*s.* Mean 70*s.*	150,729	802,291	41·6
1871									
Mar. 31	92⅛	2·7	53 7	5*d.*—7¾*d.* Mean 6⅜*d.*	5¼*d.*—7¾*d.* Mean 6½*d.*	75*s.*—100*s.* Mean 87*s.* 6*d.*	160,984	878,892	40·2
June 30	93⅜	2·5	59 9	5¼*d.*—7¾*d.* Mean 6½*d.*	5½*d*—8½*d.* Mean 7*d.*	51*s.*—76*s.* Mean 63*s.* 6*d.*	140,338	805,519	51·5
Sept. 30	93⅜	2·2	57 9	5½*d.*—8*d.* Mean 6¾*d.*	5¾*d.*—9*d.* Mean 7½*d.*	60*s.*—77*s.* Mean 68*s.* 6*d.*	132,065	769,482	61·3
Dec. 31	93	4·2	56 3	5*d.*—7¾*d.* Mean 6½*d.*	5½*d.*—8¼*d.* Mean 6¾*d.*	75*s.*—104*s.* Mean 89*s.* 6*d.*	140,955	758,474	41·8
1872									
Mar. 31	92 4/8	3·0	55 4	5*d.*—7¼*d.* Mean 6⅛*d.*	5¾*d.*—8½*d.* Mean 7⅛*d.*	80*s.*—120*s.* Mean 100*s.*	149,599	776,793	43·6
June 30	92⅞	4·0	56 8	5¼*d.*—7½*d.* Mean 6⅜*d.*	6*d.*—8¾*d.* Mean 7⅜*d.*	124*s.*—150*s.* Mean 137*s.*	134,412	724,463	52·8
Sept. 30	92 4/8	3·5	58 11	5¼*d.*—8*d.* Mean 6⅝*d.*	6¼*d.*—9¼*d.* Mean 7¾*d.*	105*s.*—133*s.* Mean 119*s.*	126,377	681,987	61·1
Dec. 31	92 2/8	5·9	57 3	5½*d.*—8*d.* Mean 6¾*d.*	6*d.*—8½*d.* Mean 7¼*d.*	154*s.*—187*s.* Mean 171*s.*	138,648	675,598	45·3

The annexed return shows the number of Beasts exhibited and the prices realised for them at the Christmas markets since 1841 :—

Year.	Beasts.		Year.	Beasts.	
		s. *d.* *s.* *d.*			*s.* *d.* *s.* *d.*
1841	4,500	3 8 to 5 0	1857	6,856	3 4 to 4 8
1842	4,541	3 4 — 4 8	1858	6,424	3 4 — 5 0
1843	4,510	4 8 — 4 4	1859	7,560	3 6 — 5 4
1844	5,713	4 0 — 4 6	1860	7,860	3 4 — 5 6
1845	5,326	3 6 — 4 8	1861	8,840	3 4 — 5 0
1846	4,570	4 0 — 5 8	1862	8,430	3 4 — 5 0
1847	4,282	3 4 — 4 8	1863	10,372	3 6 — 5 2
1848	5,942	3 4 — 4 8	1864	7,130	3 8 — 5 8
1849	5,765	3 4 — 4 0	1865	7,530	3 4 — 5 4
1850	6,341	3 0 — 3 10	1866	7,340	3 8 — 5 6
1851	6,103	2 8 — 4 2	1867	8,110	3 4 — 5 0
1852	6,271	2 8 — 4 0	1868	5,320	3 4 — 5 8
1853	7,037	3 2 — 4 10	1869	6,728	3 6 — 6 2
1854	6,181	3 6 — 5 4	1870	6,425	3 6 — 6 2
1855	7,000	3 8 — 4 2	1871	6,320	3 10 — 6 2
1856	6,748	3 4 — 5 0	1872	7,560	4 6 — 6 0

ACREAGE under each Description of Crop, Fallow, and
Great Britain and

Description of Crops and Live Stock.	Great Britain.		
	1870.	1871.	1872.
Corn Crops:—	Acres.	Acres.	Acres.
Wheat	3,500,543	3,571,894	3,598,957
Barley or Bere	2,371,739	2,385,783	2,316,332
Oats	2,763,300	2,715,707	2,705,837
Rye	65,166	71,495	66,875
Beans	530,095	540,835	524,005
Peas	317,198	389,547	361,545
Total Corn Crops	9,548,041	9,675,261	9,573,551
Green Crops:—			
Potatoes	587,661	627,691	564,088
Turnips and Swedes	2,210,911	2,163,744	2,083,507
Mangold	306,531	360,517	329,190
Carrots	15,259	20,154	16,499
Cabbage, Kohl-rabi, and Rape	143,930	178,919	177,800
Vetches, Lucerne, and any other crop (except clover or grass)	322,438	387,155	445,299
Total Green Crops	3,586,730	3,738,180	3,616,383
Other Crops, Grass, &c.:—			
Flax	23,957	17,366	15,357
Hops	60,594	60,030	61,927
Bare fallow or uncropped arable land	610,517	542,840	647,898
Clover and artificial and other grasses under rotation	4,504,884	4,369,448	4,513,451
Permanent pasture, meadow, or grass not broken up in rotation (exclusive of heath or mountain land)	12,072,856	12,435,442	12,575,606
Live Stock:—	No.	No.	No.
Cattle	5,403,317	5,337,759	5,624,994
Sheep	28,397,589	27,119,569	27,921,507
Pigs	2,171,138	2,499,602	2,771,749
Total number of horses used for agriculture, unbroken horses, and mares kept solely for breeding	1,266,709	1,254,450	1,258,020
Acreage of orchard, or of arable or grass-land, used also for fruit-trees	..	206,583	Not yet ascertained
Acreage of woods, coppices, and plantations	..	2,175,471	2,187,078

GRASS, and NUMBER of CATTLE, SHEEP, and PIGS, in IRELAND, in 1870–71–72.

IRELAND.			UNITED KINGDOM, including the Islands.		
1870.	1871.	1872.	1870.	1871.	1872.
Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
260,914	246,954	228,189	3,773,663	3,831,054	3,839,532
243,435	222,604	220,057	2,623,752	2,616,965	2,543,581
1,648,764	1,633,960	1,621,813	4,424,536	4,362,139	4,340,748
9,281	9,647	8,832	74,527	81,222	75,849
9,644	9,549	10,029	539,968	550,613	534,341
1,071	1,365	1,753	318,607	391,250	364,194
2,173,109	2,124,079	2,090,673	11,755,053	11,833,243	11,698,245
1,043,788	1,058,287	991,802	1,639,296	1,693,825	1,563,691
339,059	327,162	346,464	2,559,629	2,500,565	2,439,336
25,220	31,766	34,736	332,409	392,941	364,699
3,940	4,167	3,782	19,925	25,047	20,977
45,266	43,543	50,207	189,344	222,610	228,118
41,446	46,607	46,925	366,532	436,410	495,173
1,498,719	1,511,532	1,473,916	5,107,135	5,271,398	5,111,994
194,893	156,883	122,003	218,870	174,269	137,360
..	..	..	60,594	60,030	61,931
19,054	22,323	18,512	630,294	565,886	667,299
1,775,835	1,827,733	1,799,930	6,320,126	6,236,588	6,354,319
9,990,968	10,068,848	10,241,513	22,085,295	22,525,761	22,838,178
No.	No.	No.	No.	No.	No.
3,796,380	3,973,102	4,057,153	9,235,052	9,346,216	9,718,505
4,333,984	4,228,721	4,262,117	32,786,783	31,403,500	32,246,642
1,459,332	1,616,754	1,385,386	3,650,730	4,136,616	4,178,000
531,306	537,633	540,745	1,808,040	1,802,108	1,808,259
..	..	..	..	..	..
320,853	324,285	..	..	..	..

Average Prices of British Wheat, Barley, and Oats, per Imperial Quarter, in each of the Sixteen Years 1857–72.

Year.	Wheat.	Barley.	Oats.	Year.	Wheat.	Barley.	Oats.
	s. d.	s. d.	s. d.		s. d.	s. d.	s. d.
1857	56 4	42 1	25 0	1865	41 10	29 9	21 10
1858	44 2	34 8	24 6	1866	49 11	37 5	24 7
1859	43 9	33 6	23 2	1867	64 6	40 0	26 1
1860	53 3	36 7	24 5	1868	63 9	43 0	28 1
1861	55 4	36 1	23 9	1869	48 2	39 5	26 0
1862	55 5	35 1	22 7	1870	46 10	34 7	22 10
1863	44 9	33 11	21 2	1871	56 10	36 2	25 2
1864	40 2	29 11	20 1	1872	57 0	37 4	23 2

Certain Articles of Foreign and Colonial Production Imported in the Years 1869–72; and their Quantities.

	1869.	1870.	1871.	1872.
Animals, Living:				
Oxen, Bulls, and Cows, number	190,674	170,647	208,772	139,37[illegible]
Calves .. .. ,,	29,516	31,525	40,139	33,5[illegible]
Sheep .. .. ,,	691,472	651,138	916,799 (Sheep and Lambs)	809,81[illegible] (Sheep and Lambs)
Lambs .. .. ,,	18,371	18,767		
Swine and Hogs .. .. ,,	69,067	95,624	85,622	16,1[illegible]
Bones (burnt or not, or as animal charcoal) .. .. tons	95,980	94,923	94,212	97,7[illegible]
Cotton, Raw .. .. .. cwts.	10,900,818	11,931,979	15,843,890	12,641,0[illegible]
Flax .. .. ,,	1,542,201	2,373,528	2,597,915	2,017,3[illegible]
Guano .. .. ,,	210,010	280,311	178,678	117,0[illegible]
Hemp .. .. ,,	1,055,769	1,108,839	1,320,747	1,103,5[illegible]
Hops .. .. ,,	322,515	127,013	220,409	137,4[illegible]
Hides untanned: Dry .. ,,	340,449	527,809	599,922	815,5[illegible]
,, ,, Wet .. ,,	524,899	670,941	678,433	626,0[illegible]
Petroleum .. .. tuns	21,439	27,220	35,808	25,3[illegible]
Oilseed Cakes .. .. .. tons	159,295	158,211	162,613	1,254,1[illegible]
Potatoes .. .. cwts.	1,660,189	772,003	852,125	6,029,9[illegible]
Butter .. .. ,,	1,259,089	1,159,481	1,337,808	1,138,4[illegible]
Cheese .. .. ,,	979,189	1,041,281	1,219,056	1,060,1[illegible]
Eggs .. .. per great hundred	3,684,772	3,590,352	1,351,106	4,650,[illegible]
Lard .. .. cwts.	255,964	217,696	477,147	1,308,[illegible]
Bacon and Hams .. .. ,,	740,193	567,164	1,143,873	2,244,[illegible]
Salt Beef .. .. ,,	214,955	203,713	279,179	193,[illegible]
Salt Pork .. .. ,,	165,944	220,533	266,967	212,[illegible]
Clover Seeds .. .. .. ,,	231,427	155,673	340,377	292,[illegible]
Flax-seed and Linseed .. qrs.	1,397,066	1,490,695	1,334,945	1,510,[illegible]
Rape .. .. ,,	260,212	551,107	665,161	249,[illegible]
Sheep and Lambs' Wool .. lbs.	255,161,344	259,361,963	319,511,336	302,909,[illegible]

STATISTICS OF DAIRY PRODUCE.

(*The following Quotations, &c., are extracted from* 'The Grocer.')

PRICES CURRENT on 1st SATURDAY in JANUARY of each YEAR, from the latest actual MARKET SALES.

	1873.	1872.	1871.	1870.
Butter:	Per cwt.	Per cwt.	Per cwt.	Per cwt.
Carlow, finest, F.O.B. ..	120s. to 132s.	120s. to 134s.	130s. to 144s.	124s. to 130s.
Landed	120 ,, 134	116 ,, 136	126 ,, 146	122 ,, 130
Cork, 1sts	136 ,, 142	133 ,, 137	142 ,, 150	134 ,, 137
,, 2nds	128 ,, 133	124 ,, 129	134 ,, 142	123 ,, 125
,, 3rds, new	100 ,, 106	106 ,, 118	122 ,, 125	107 ,, 109
,, 4ths ,, ...	87 ,, 89	84 ,, 86	112 ,, 114	100 ,, 104
Limerick	110 ,, 114	112 ,, 116	128 ,, 132	116 ,, 120
Foreign:				
Friesland	112 ,, 122	106 ,, 116	112 ,, 142	104 ,, 132
Jersey, &c.	74 ,, 120	75 ,, 124	76 ,, 130	74 ,, 130
Kiel	112 ,, 146	100 ,, 140	110 ,, 156	104 ,, 136
Normandy	90 ,, 150	90 ,, 150	.. ..	90 ,, 150
American	60 ,, 105	60 ,, 115	94 ,, 116	100 ,, 112
Cheese:				
English Cheddar, fine, new	70 ,, 90	66 ,, 84	.. ..	90 ,, 94
,, good ,,	.. ..	.. ..	74 ,, 100	74 ,, 86
Red Somerset Loaf	70 ,, 76	50 ,, 72	80 ,, 92	72 ,, 84
White or yellow Cheddar Loaf	68 ,, 80	60 ,, 70	80 ,, 92	76 ,, 84
Scotch Cheddar	66 ,, 76	60 ,, 70	70 ,, 80	70 ,, 80
Cheshire, new	70 ,, 84	70 ,, 84	78 ,, 90	84 ,, 90
,, good ditto ..	56 ,, 66	50 ,, 64	60 ,, 74	66 ,, 78
Wiltshire, new ..	66 ,, 76	64 ,, 70	64 ,, 84	72 ,, 80
,, good ditto ..	56 ,, 60	50 ,, 60	.. ..	62 ,, 68
North Wilts, Loaf, new ..	60 ,, 76	50 ,, 72	80 ,, 90	76 ,, 84
Derby ,,	60 ,, 78	56 ,, 78	68 ,, 86	72 ,, 86
Foreign:				
American, fine	66 ,, 72	60 ,, 66	74 ,, 80	72 ,, 75
,, good	50 ,, 62	40 ,, 56	60 ,, 68	64 ,, 70
Gouda	50 ,, 64	40 ,, 64	50 ,, 64	50 ,, 62
Kanter	.. ..	.. ..	.. ..	.. ..
Edam, new	52 ,, 68	50 ,, 70	54 ,, 70	54 ,, 65

During the year 1872 the provision market no longer suffered from the effects of drought, or from the prohibition of shipments of butter from France through war. The following remarks relating to Irish and Foreign Butter and to Cheese are extracted from 'The Grocer.'

IRISH BUTTER.—The sale of Irish butter, in January, was slow, but the quantity of really fine on offer being small, quotations showed scarcely any change. Clonmels quoted at 118*s.* to 134*s.*, and Cork firsts at 134s. to 138s. In February, the quotations differed but little from those of last month. The large quantities of inferior foreign operated against inferior Irish. In March, the market showed a slight improvement for finest qualities. Scarcely any Irish butter of fine quality was left unsold in April; holders of other kinds were anxious to clear out. The Cork butter market opened with new brands on the 22nd with quotations at—firsts, 130s.; seconds, 130s.; thirds, 99s.; and fourths, 60s. In June, the sales of Irish butter were very few. In July, a little more business was transacted than in the previous month. Early in September, the transactions were few, the month, however, closed with more doing at higher rates. In November, the demand for most descriptions was inactive. In the last month of the year the operations in the Irish butter market were few, but the chief part of the little done was in sales of third and fourth Corks. These in the early part of the month were taken pretty freely at 98s. to 99s. for fresh parcels of thirds and fourths at 88s. to 90s.; a few firsts changed hands at 130s. to 131s.

" Cork Butter Market.—During the early months of the year there is little to be said of the operations in this market; the supply is always then limited, but the demand equally so, the dealers having stocked themselves before Christmas, when butter of fine quality is procurable. The real work of the season commences in April or May, when the market re-opens, after being generally closed for two or three weeks. In 1872 the new season commenced on May 1, when there was a fair supply of new grass butter, which sold at 140s. for first quality, 130s. for second, and 100s. for third. These very high prices of course do not hold long, and by May 9, under the influence of fine weather and the expectation of a plenty which is always anticipated at that season, the lowest point of the year was almost touched, firsts being then 112s. and seconds 101s., after which they advanced again; so that during the month of June these qualities ranged several shillings higher, and were at one period as high as 115s. and 109s. The excess of rain during the summer banished all fear of a short supply, and this feeling, coupled with an easier demand from England, kept prices very steady and brought them back again; so that few years have passed which show less variation, seconds being in December the same as they were in September, the price having scarcely varied since then. Though the supplies were very heavy during the autumn, and considerably larger than at the corresponding period of the previous year, yet, on the whole, the receipts of butter to the market for the eleven months ending November 30 show a trifling falling off, the numbers for the first eleven months of 1871 being

376,200 firkins against 376,086 for the same period of 1872; but as 1871 was one of the largest on record, the deficiency of 114 firkins is of no moment, and this market may fairly be described as progressing in every respect.

"Foreign Butter.—January commenced and finished with a heavy stock of foreign butter—say 26,000 packages at the public wharves, besides large quantities in private stores, a very large portion of it so inferior in quality that it was found to be almost impossible to force it into consumption for human food; the result was a wide range of prices at the beginning of the month. March commenced with a heavy stock of foreign butter, chiefly of inferior quality, and nearly unsaleable, 140*s.* to 156*s.* were selling prices for finest Normandy up to the 20th. Although the supplies of best Normandy's were not large in April, prices, in the face of an increase in the make of fine English gave way 5*s.*, the first week in the month from 150*s.* to 145*s.*, and the fourth week 124*s.* A large quantity of inferior foreign still lying nearly unsaleable. In June, the supply of foreign butter was a full average one; finest qualities preponderating. A large quantity of inferior still on hand. The supply of foreign butter in July was about the average; in August with cooler weather the arrivals came to hand in better condition. In September, the market was heavily stocked with old inferior foreign, but there was less of that called adulterated coming forward. In October inferior qualities were not shipped as freely as last season—dealers being afraid of the Adulteration of Food Act. In December, supplies of best Normandy's fell off; on the finest the demand was active, the chief rates for such varying from 134*s.* to 146*s.* A good deal of the inferior qualities, many of them last season's shipments of repacks, &c., still lying here nearly unsaleable, although offered at little if anything above grease prices.

"Cheese.—The variation in prices, throughout January, was very trifling; fine qualities were scarce. Quotations for Cheddar were 70*s.* to 84*s.*, American, fine, 60*s.* to 66*s.* In February a great falling off in the arrivals of American cheese into Liverpool gave more confidence to holders. In March, really fine English was scarce, but there was a plentiful supply of second-rate qualities. The range in prices of Cheddar was from 60*s.* to 90*s.*, Cheshire from 20*s.* to 64*s.* for common descriptions, and 70*s.* to 84*s.* for best. Arrivals of American during this month fell off very much. Throughout April quotations varied little; really fine English still scarce. The asking rates for choice Cheddar 86*s.* to 90*s.* downward to 60*s.* for common. In consequence of small arrivals of American the moderate priced English were more easily disposed of. American commenced at 66*s.* to 74*s.* for best; the rates current in America left no profit for shippers at these prices. For the little fine quantity of English cheese left on hand in June, high rates were obtained. New American found buyers fast to hand. In July, the season for fine old English may be said to be brought to a close, and the weather this season has been too warm to bring new freely to market; 86*s.* to 90*s.* still quoted for finest Cheddar, and 80*s.* to 88*s* for finest Cheshire. American has arrived more freely and—to prevent accumulation of stocks—has been offered at moderate prices; 58*s.* to 62*s.* In October, arrivals of American fell off considerably in quantity. In December, the extreme quotations for Cheddar were 70*s.* to 90*s.*, Cheshire 74*s.* to 84*s.* for best, and 56*s.* to 64*s.* for middling quality. American best 66*s.* to 70*s.*, a few at 72*s.*, and middling parcels 56*s.* to 60*s.*

"According to the 'New York Shipping and Commercial List' of August 31, the American export trade in cheese has assumed enormous proportions, England taking nearly all the surplus product.

"It is mainly," it adds, "carried in steamers, and the rate this season has been quite uniform at 40*s.* to Liverpool and 50*s.* to London. The price of American cheese has lately advanced in the English market, with a corresponding rise here. The competition among English buyers is so sharp that they do not wait for the product to reach our market, but contract for it at the sources of supply often before it is made. The shipments hence to England have for some time past averaged about 100,000 boxes weekly, the freight engagements in a single day this week having reached 65,000 boxes—by far the largest transactions which have ever before been made in a single day. Prime State Factory cheese has been selling the present week at 13 to 14½ cents, the latter price for a fancy article. Some of the dealers are doubtful if the present prices in the English market can be sustained, and seem to look for an early reaction. Stocks here are sold up close to the production, and contracts in some instances have been made ahead, and, as meat provisions in England are scarce and dear, the reliance of her population must necessarily be more than ever upon cheese,—a circumstance that would seem to lessen the chances of a return to lower prices."

STATEMENT of the QUANTITY and VALUE of BUTTER imported from the UNITED STATES, BELGIUM, FRANCE, and HOLLAND; and of CHEESE imported from the UNITED STATES and HOLLAND, 1864–71.

Years.	UNITED STATES.			
	Butter.		Cheese.	
	Quantities.	Computed Real Value.	Quantities.	Computed Real Value.
	Cwts.	£.	Cwts.	£.
1864 ..	142,672	780,024	466,988	1,213,890
1865 ..	83,216	437,703	442,913	1,296,204
1866 ..	16,059	77,754	415,726	1,386,447
1867 ..	39,035	113,290	526,740	1,470,017
1868 ..	7,117	37,279	489,117	1,439,380
1869 ..	17,203	84,603	487,870	1,612,325
1870 ..	16,915	80,928	555,385	1,861,263
1871 ..	83,775	394,359	731,326	2,014,805

Years.	BELGIUM.		FRANCE.	
	Butter.		Butter.	
	Cwts.	£.	Cwts.	£.
1864 ..	81,575	470,167	163,020	858,793
1865 ..	70,619	433,179	353,115	1,867,085
1866 ..	76,667	426,712	452,196	2,276,493
1867 ..	80,754	470,464	450,693	2,265,147
1868 ..	70,456	405,987	393,578	2,156,824
1869 ..	85,789	481,609	407,432	2,231,450
1870 ..	84,408	516,643	289,692	1,672,899
1871 ..	94,539	523,460	304,683	1,636,006

Years.	HOLLAND.			
	Butter.		Cheese.	
	Cwts.	£.	Cwts.	£.
1864 ..	336,224	1,774,462	336,831	881,972
1865 ..	345,026	1,886,486	386,962	1,100,037
1866 ..	383,225	1,979,070	426,559	1,317,231
1867 ..	326,217	1,733,459	332,628	961,245
1868 ..	343,322	1,992,414	329,565	959,547
1869 ..	415,176	2,253,420	426,913	1,262,101
1870 ..	406,795	2,388,459	422,553	1,204,830
1871 ..	390,616	1,986,708	348,148	954,236

JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

I.—*On the Characters of Pure and Mixed Linseed-Cakes.* By Dr. Augustus Voelcker, F.R.S.

In the course of a long experience in examining feeding materials of every description, oilcakes have been brought under my notice, ranging in quality from fine pure linseed-cake down to compounds of all kinds of refuse matters pressed into cake, with a little linseed, and hardly deserving the name of oilcake. During a single year from 150 to over 200 samples of various kinds of feeding cakes and meals are usually submitted to me for examination.

The annual and quarterly Reports issued by the Chemical Committee of the Royal Agricultural Society afford abundant evidence of the prevalence of endeavours to induce the farmer to buy mixed in preference to pure linseed-cakes. This system unfortunately finds too much encouragement in the inclination of many agriculturists to buy cakes at prices at which it is impossible to produce genuine linseed-cakes.

Notwithstanding frequent public exposures, and the known danger which the buyer of cheap cakes runs of injuring the health of his stock, it is a notorious fact that in many markets really "Pure Linseed-Cake" is an almost unsaleable commodity; and inferior, mixed, and adulterated cakes are freely bought on account of the temptingly low prices at which they are offered. Many cakes improperly sold as linseed-cakes, at prices varying from 2*l.* to 3*l.* below the market price of pure linseed-cake, have but little in common with the genuine article; for they contain only a little linseed, artfully squeezed into cake with earth-nut, cotton, beech-nut, rape, and other feeding cakes, together with bran, rice-husks, oat-dust, and a host of other materials to which reference will be made in this paper.

Such cakes, although apparently cheap, in reality are dear at the price at which they are sold, and less economical than the more expensive and more nutritious pure linseed-cake.

Makers of pure linseed-cake cannot afford to pay so high a commission to their agents, or to country dealers, as the crushers who incorporate with their cakes rice-dust, pollard, oat-dust, and other cheap materials of questionable feeding value. Thus it happens that the sale of inferior and occasionally downright bad and unwholesome feeding-cakes is encouraged to the manifest disadvantage of the stockfeeder. There are, of course, exceptions to the prevailing inclination of many to buy cheap cakes. In the neighbourhood of Gainsborough, for instance, pure linseed-cake finds a ready sale, and the frequenter of Gainsborough market, and several other agricultural centres in Lincolnshire and in Norfolk, has the choice between at least half a dozen equally good pure linseed-cakes of rival makers.

Amongst the numerous samples which have passed through my hands, I found some cakes unmistakeably poisonous, others of a doubtful character, and a great many, considering their low feeding value, far too dear at the price at which they were bought.

Few feeding-cakes contain ingredients so positively poisonous as to render the cake unfit as food for sheep or cattle. In most cases, cakes reported to have done mischief to stock, I find do not contain poisonous matters capable of being isolated by chemical analysis or by the microscope. Of late years, instances of death or injury to stock supposed to have been caused by the cake upon which the animals were fed, have been again and again brought under my notice, and in several cases the circumstances under which the animals died strongly pointed out the cake as the most likely cause of their death. Considering the large number of suspected cakes that have been referred to me for examination, I have come to the conclusion that the deleterious character of some cakes cannot be recognised by any known chemical test, and is only recognisable in the disastrous effects which they produce on the animal system. It may be a coincidence, but it is nevertheless a remarkable fact, that, to my recollection, in almost all cases in which I had to examine cakes for poisonous ingredients, mixed or compound feeding-cakes were sent to me to report upon. Whilst I can refer to dozens of cases in which inferior linseed-cakes, or specially prepared compound feeding-cakes, were reported to me as having done serious injury to stock, I do not recollect more than one or two instances in which pure linseed-cake was supposed to have been injurious to the health of the animals to whom it was given.

That bad or inferior, and especially mouldy, cakes occasionally do serious mischief to stock is an undeniable fact, but the cause of the injury is still enveloped in much mystery. The subject has engaged the careful attention of the Chemical Committee, at whose request I have undertaken to investigate the cause or causes of the injury to stock which feeding-cakes occasionally produce.

The main object of the present paper is to lay before the readers of the Journal the results of my inquiries into the causes which render some kinds of feeding-cake either positively unfit as food for animals, or which account for the practical observation that oilcake sometimes does more harm than good to sheep or cattle. At the same time I purpose to bring out some facts which I trust may afford to the breeder and feeder of stock some useful hints in warning him in time of the risks he runs in buying cheap mixed cakes, and of enabling him to distinguish pure and wholesome, from adulterated or inferior linseed-cakes.

The nutritive value of feeding-cakes depends not merely upon their proximate composition, but likewise upon their physical condition. Like other perishable articles of food, linseed-cake, when kept in a damp or badly ventilated place, rapidly turns mouldy, and after some time becomes unfit for feeding purposes.

I propose to discuss the subject under the following heads:—

1. The composition and characters of pure linseed-cake, and the means of distinguishing genuine from inferior or adulterated cakes.

2. Materials used in the manufacture of mixed or compound feeding-cakes, and the composition, structure, and properties of various substances employed for adulterating linseed-cake.

3. Composition and properties of inferior and adulterated mixed cakes.

4. Remarks on the causes which render feeding-cakes either poisonous or more or less injurious and dangerous to the health of stock.

I shall endeavour to confine my remarks to matters which have come under my personal notice, and not to relate the experience of others who have written on the adulteration of linseed-cake.

I.—The Composition and Characters of pure Linseed-Cake, and the means of distinguishing Genuine from Inferior or Adulterated Cakes.

Pure linseed-cake ought to be made from nothing else but clean or screened linseed. Such seed is not absolutely pure, for the best samples of screened commercial linseed usually contain a small amount of weed-seeds which cannot be entirely separated by screening. There is, however, no difficulty in cleaning linseed so effectually that not more than 4 to 5 per cent. of small seeds and other impurities are left in it; and for all practical purposes such seed may be regarded as pure.

India and Russia are the great linseed producing countries of the world. From India we obtain Bombay and Calcutta linseed, and from Russia linseed is exported into England from St. Petersburg, Archangel, Riga, and other ports of the Baltic in the North, and from the ports of the Black Sea in the South. The trade at the Black Sea Ports is almost entirely in the hands of Greek merchants, whilst the export business in the Baltic Ports is chiefly regulated by an old-established colony of English merchants, and by several German houses of business.

Apart from the accidental impurities that occur in commercial samples, linseed varies to some extent in its composition, feeding properties, and general appearance, according to the country in which it was grown, the season, and its state of maturity.

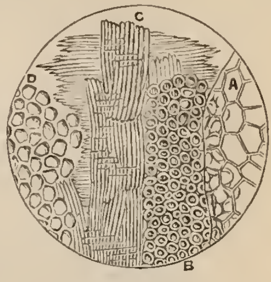
With a view of obtaining some idea of the variations to which the composition of linseed is subject, I made the following analyses of pure seed picked from fair commercial samples of Bombay, Morshanski, Medium Riga, Petersburg, Black Sea, and fine Alexandria linseed:—

Table I.—Composition of Different Kinds of absolutely Pure Linseed.

	Bombay Linseed.	Morshanski Linseed.	Black Sea Linseed.	Riga Linseed.	St. Petersburg Linseed.	Alexandria Linseed.
Moisture	8·01	10·01	10·40	10·64	9·61	5·47
Oil	38·21	30·81	30·78	31·19	35·32	35·73
* Albuminous compounds (flesh-forming matter)	21·81	25·60	26·62	22·19	20·19	19·31
Mucilage, sugar, and digestible fibre	20·85	21·51	17·30	22·71	24·71	26·22
Woody fibre (cellulose) ..	8·36	8·30	11·40	9·38	5·91	8·70
Mineral matter (ash) ..	2·76	3·77	3·50	3·89	4·26	4·57
	100·00	100·10	100·00	100·00	100·00	100·00
* Containing nitrogen.. ..	3·49	4·10	4·26	3·55	3·23	3·09

Some kinds of linseed, it will be seen from the preceding tabular statement, yield a good deal more oil than others. The quantity of albuminous compounds in different samples, and to a minor extent that of woody fibre, and of ash, is likewise subject to fluctuations. Speaking generally, Baltic linseed, more especially from Morshanski seed, has a finer skin, is smaller, and produces a more nutritious cake than Bombay linseed. Bombay linseed has a lighter colour than Black Sea or Baltic linseed, and becomes less gelatinous than the latter when mixed with water. The annexed woodcut represents the structure of linseed under a quarter-inch power of a compound microscope.

Fig. 1.—*Section of Linseed.*



A the outer skin or layer.
B the second layer.
C the third layer.
D the fourth layer.

In the next illustrations Petersburg and Bombay linseed are represented of their natural size, and magnified to 140 diameters :—

Fig. 2.—*Exterior of Bombay Linseed.*

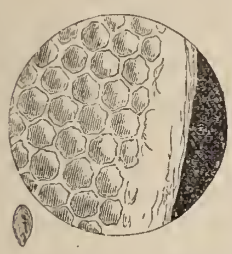
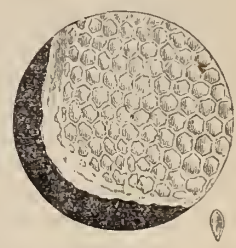


Fig. 3.—*Exterior of Petersburg Linseed.*



Seeds, natural size ; exterior magnified 140 diameters.

Linseed, as imported, always contains more or less dirt and small weed-seeds, which, however, can be readily separated from it by screening. The percentage of the impurities in commercial samples varies extremely ; in some samples it is as low as from 3 to 4 per cent. ; in others as high as 50 per cent. and more. Some years ago I obtained about a dozen samples of linseed from various sources, and determined in each the amount of foreign seeds and other impurities, and as the results of these mechanical analyses throw light on the remarkable differences in the quality of linseed-cakes professing to be genuine, I give them in the following list:—

Foreign Seeds and Impurities in Samples of Linseed.

	Per cent.
Bombay linseed	$4\frac{1}{2}$
Finest Bombay seed	$1\frac{3}{4}$
Black Sea seed	20
" " 2nd sample	12
" " 3rd "	19
Odessa linseed	$12\frac{1}{2}$
Morshanski seed	7
Fine Petersburg seed	3
Petersburg Rijeff (common) seed	41
" " " 2nd quality	$43\frac{1}{2}$
" " " 3rd "	70
Medium Riga seed	35
Riga crushing seed	42
" " 2nd sample	$49\frac{1}{2}$

No one can look on that list without feeling astonished at the large amount of foreign weed-seeds that occur in commercial linseed, which is pressed and made into cakes that are sold as genuine linseed-cakes. In good samples of linseed seldom more than from 5 to 8 per cent. of foreign seeds occur. When gathered from foul land, the flax crop necessarily yields linseed contaminated to a considerable extent with the seeds from a variety of weeds grown amongst the flax, but probably the foulest fields overrun with charlock and other weeds do not produce linseed containing more than from 25 to 30 per cent. of foreign impurities. It will appear, therefore, that the 49 or 70 per cent. of impurities which I actually found in two of the samples referred to in the preceding table, could not have grown amongst the flax from which the seed was produced. In fact, linseed is frequently adulterated before it is landed in England. Most of the foreign seeds in linseed are smaller than the latter, and can be readily removed from it by sifting. This is actually done in producing fine samples that are sold to the makers of pure linseed-cake, or to oil-crushers prepared to pay a proper price for clean linseed. The impurities or siftings, however, are too valuable to be thrown away; they have, indeed, a peculiar value of their own, for they are used for mixing with linseed in certain proportions, and producing second, third, and fourth qualities of Riga, Petersburg, and other varieties. I have been assured by persons well acquainted with dealings in genuine linseed that the siftings from it are mostly used for producing cheap linseed. Occasionally barges laden with the siftings are sent out a little way to sea, to meet ships having on board linseed, and coming from one of the ports in the North. An amalgamation of the siftings with the linseed is effected on the high sea, and the mixture, containing a greater or less quantity of siftings, is then imported, and sold as linseed "genuine as imported." A good deal of so-called genuine linseed-cake is made from such seed. It is well to bear in mind that a guarantee which describes a cake as made from linseed, "genuine as imported," in point of fact is no guarantee at all, for it is a well-known fact that very dirty linseed, not unfrequently containing more than half its weight of foreign weed-seeds, is freely imported into Hull and other ports.

Some of the weed-seeds which compose the bulk of the siftings and screenings from linseed, like the seeds of the purging flax, wild mustard, and wild radish, possess decidedly injurious properties; others, like darnel and corn-cockle seed, are reputed to be unwholesome, and the remainder have no great value as feeding materials, while many give a bad flavour to the cake.

Amongst the weed-seeds in commercial linseed I have found the following:—

1. Rape-seed (*Brassica Rapa*).
2. Indian rape (*Sinapis glauca*).

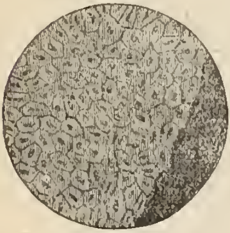
When rape-seed occurs in linseed-cake in appreciably large proportions, it imparts to the cake a somewhat pungent and turnip-like flavour. From linseed-cake adulterated with rape-seed, portions of the brown cuticle may easily be separated, and these examined under the microscope will exhibit the structure represented in the accompanying woodcuts. The proportion of nitrogenous compounds in two samples of rape-seed I found to amount to 18·50 per cent. in best Indian rape-seed, and 19·43 in English rape-seed.

3. Red or wild mustard, charlock or ketlock (*Sinapis arvensis*).
4. White mustard (*Sinapis alba*). Red and white mustard, on digestion with water, produce highly pungent essential oils. Linseed-cake contaminated with mustard, when made into jelly with water, and allowed to stand for an hour or thereabout in a warm place, develops the peculiarly pungent smell of oil of mustard.

The cuticle of mustard-seed resembles in appearance that of rape. It may, however, be distinguished from the latter by the hexagonal cells which appear quite marked under the microscope, when examined with a $\frac{1}{4}$-inch lens, as will be seen in the accompanying representations of the epidermis or cuticle.

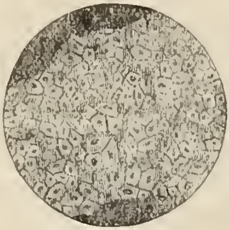
Figs. 4–6.—*Exteriors of Rape and Mustard.*

Fig. 4.—*Common Rape.*



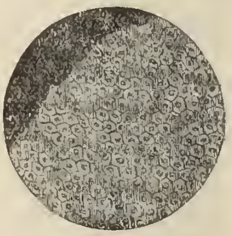
× 195 Diameters.

Fig. 5.—*Indian Rape.*



× 195 Diameters.

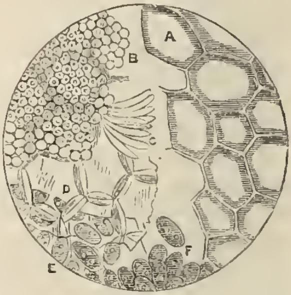
Fig. 6.—*Red Mustard.*



× 195 Diameters.

Fig. 7.—*Section of Red Mustard.*

Fig. 8.—*Section of White Mustard.*



A. Outer skin or layer.
B. Second layer.
C. Third layer.
D. Fourth layer.
E. Fifth layer.
F. Oil-cells.

In a sample of wild mustard-seed, or charlock, taken from linseed, I found:—

Nitrogen	3·99
Equal to albuminous compounds	24·93
Mineral matter (ash)	5·13

5. Yellow Dodder (*Camelina sativa*). This is a bright yellow seed, of about the size of cress-seed, and resembling it in its general structure. Dodder or camelina-seed occurs almost always, and, speaking comparatively, in large proportions in

Baltic linseed, especially in common Petersburg or Rijeff-seed. It imparts to cake made from such linseed a disagreeable garlic-like taste. In a sample of camelina-seed, from Petersburg linseed, I found :—

Nitrogen	3·46
Equal to albuminous compounds	21·62

Fig. 9.—*Camelina sativa (Dodder).*

× 140 Diameters.

The yellow dodder seed must not be confounded with flax-dodder, vulgarly called Devil's-guts, that also occurs in linseed.

6. Flax Dodder—Devil's-guts (*Cuscuta Epilinum*). A small, round, dirty, greenish-brown seed, which often occurs in large quantities in foreign linseed.

7. Purging flax (*Linum catharticum*). This is a small shining yellow seed, possessing purging properties.

8. Corn-cockle (*Githago segetum*, Desf., or *Agrostemma Githago*, L.). A farinaceous seed, forming ovoid capsules, with a black striated epidermis. In a sample of corn-cockle-seed I found :—

Nitrogen	2·56
Equal to albuminous compounds	16·01

The seeds of corn-cockle are considered to render flour unwholesome when ground along with it.

9. Heartsease or wild pansy (*Viola tricolor*).

10. Millet-seed.

11. Bluebottle or corn-flower (*Centaurea Cyanus*). A grey silky seed, with dirty white pappus. A sample taken from linseed yielded :—

Nitrogen	2·31
Equal to albuminous compounds	14·41

12. Knap-weed (*Centaurea nigra*).

13. Docks and Sheep Sorrel (*Rumex Acetosella*) and several others. Small, triangular, yellowish-brown seeds, of various species of Rumex.

14. Goosefoot-seed (*Chenopodium*). Small, black, shining hard seeds. A sample of Chenopodium seed found in linseed contained :—

Nitrogen	2·56
Equal to albuminous compounds	16·01

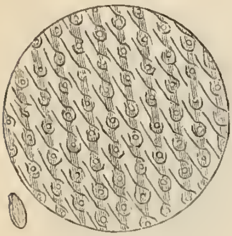
15. Dandelion seed (*Leontodon Taraxacum*).

16. Wild radish (*Raphanus Raphanistrum*). A very pungent seed which imparts a nasty taste to linseed-cake.

17. Cleavers or goosegrass-seeds (*Galium aparine*).

18. Darnel-seed, Drunken Darnel (*Lolium temulentum*). This is a large grass-seed resembling somewhat in appearance rye. It is reputed to possess intoxicating properties. In a sample of darnel-seed I found:—

Fig. 10.—*Darnel-seed. Lolium temulentum.*



×140.—Diameter.

Nitrogen	1·89
Equal to albuminous compounds	11·81

19. Several species of lotus and similar papilionaceous seeds.

20. Spurry (*Spergula arvensis*). A dull black, small, round seed, containing much starch. Spurry, which is abundant in some kinds of linseed, gives a peculiar flavour to linseed-cake, reminding one of the smell of a cage in which canary birds are kept. From an analysis of spurry-seed I obtained the following results:—

Moisture	12·53
Oil	10·19
*Nitrogenous compounds	5·62
Starch and digestible fibre	59·13
Woody fibre (cellulose)	8·86
Mineral matter (ash)	3·67
	100·00
*Containing nitrogen	·90

Spurry-seed, it will be seen, is not, strictly speaking, an oily seed; it is poor in albuminous compounds, but contains a large proportion of starch.

21. Knot-grass (*Polygonum aviculare*). A brown leathery seed, minutely striate and punctate. Is very common in dirty linseed.

Fig. 11. — *Knot-grass seed. Polygonum aviculare.*

×140.—Diameter.

22. Black bindweed (*Polygonum Convolvulus*). A triangular seed, resembling buckwheat, but smaller.

23. Buckwheat (*Polygonum Fagopyrum*). A farinaceous seed, which occurs in some kinds of linseed in considerable quantities.

24. Various kinds of clover-seed.

25. A number of grass-seeds.

The seeds here mentioned are readily recognised in dirty linseed by any one who has had some experience in botanical examinations. A professional botanist, no doubt, would find a host of other weed-seeds in the screenings from linseed. The preceding list, however, is sufficiently long to show the varied character of the weed-seeds in linseed, and affords abundant evidence that good and wholesome linseed-cake cannot be made from dirty linseed, and that cake which is made from little else but linseed-siftings is not food fit for cattle.

Good linseed-cake, when examined by an ordinary pocket-lens, ought to exhibit nothing but crushed linseed. If a hundred grains of ground pure linseed-cake are mixed with 4 ounces of hot water, and the mixture stirred up occasionally, it will form, after an hour's time, a thick jelly, possessing an agreeable taste and nice smell. Pure linseed-cake, in good condition, colours the water in this experiment only slightly yellow, and the solution appears neither acid nor alkaline when tested with Litmus-paper. A portion of the powdered cake boiled with distilled-water in a test-tube, and allowed to become perfectly cool by plunging it in cold water, gives no reaction, or only a faint greenish colour, on the addition of a few drops of Iodine solution, showing the absence of starch in perfectly pure linseed-cake, or the presence of mere traces of starchy matter occurring in the farinaceous seeds, which in minute proportions occured in the linseed. By these simple means pure linseed-cake can be readily distinguished from inferior, mixed, or adulterated cake.

The composition of equally pure linseed-cakes varies considerably, as will be seen in the following tables, in which are grouped together analyses of three species of linseed-cake. Table II. contains a selection from a large number of analyses of pure linseed-cakes, all very rich in albuminous compounds. Table III. gives the analyses of pure linseed-cakes of a fair average composition; and Table IV. shows the composition of a number of pure linseed-cakes, comparatively poor in albuminous matter.

In Tables II. and IV., I have introduced the highest and lowest proportion of albuminous compounds which I ever found in pure linseed-cake; and have selected the analyses from a large number, with a view of exhibiting the extent of the variations to which the composition of such cake is liable. This appeared to me desirable, because the question has frequently been asked of me, what is the composition of pure linseed-cake? a question which cannot be answered in a categorical manner. Indeed, as will be shown presently, the fair average proximate composition of pure linseed-cake can be closely imitated and obtained by introducing into the compound cake carefully selected cheap materials other than linseed, some poor and others rich in albuminous matters, and feeding materials rich in oil together with starchy refuse matter. If, therefore, an analysis of a feeding-cake shows a close

TABLE II.—COMPOSITION of PURE LINSEED-CAKES, rich in ALBUMINOUS COMPOUNDS.

	American Cakes.		English Cake made from Baltic Seed.	English Cake.	American Cake.	English Cake.	English Cake.	English Cake.	Marseilles Cake.	American Cake.
Moisture	9·90	11·44	14·93	10·26	11·66	12·01	12·17	13·34	11·62	11·10
Oil	11·62	10·97	11·81	12·28	13·80	12·36	10·44	11·90	10·32	14·90
* Albuminous compounds (flesh-forming matters)	35·31	34·19	33·06	31·94	30·50	33·01	33·25	31·75	31·18	31·44
Mucilage, sugar, and digestible fibre ..	25·55	27·52	20·06	30·22	25·10	22·70	24·65	25·77	26·24	24·28
Woody fibre (cellulose)	11·94	8·86	14·06	8·58	12·02	14·19	13·33	11·14	11·91	12·68
† Mineral matter (ash)	5·68	7·02	5·74	6·72	6·92	5·73	6·14	6·10	8·73	5·60
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
* Containing nitrogen	5·65	5·47	5·29	5·11	4·88	5·28	5·32	5·08	4·99	5·03
† Containing sand	·78	1·54	·96	1·82	1·74	·57	·83	·60	1·77	·83

TABLE III.—COMPOSITION of PURE LINSEED-CAKES, containing an average amount of ALBUMINOUS COMPOUNDS.

	English Cakes.			American Cakes.		
Moisture	11·53	12·41	13·62	10·54	9·44	11·88
Oil	15·84	15·64	13·96	12·35	10·22	10·94
* Albuminous compounds (flesh-forming matters)	28·06	27·87	28·87	26·44	27·43	28·18
Mucilage, sugar, and digestible fibre	22·46	23·79	25·43	27·91	36·41	27·44
Woody fibre (cellulose) ..	15·18	14·85	12·72	15·38	10·68	14·66
† Mineral matter (ash) ..	6·93	5·44	5·40	7·38	6·02	6·90
	100·00	100·00	100·00	100·00	100·00	100·00
* Containing nitrogen ..	4·49	4·46	4·62	4·23	4·39	4·51
† Containing sand	1·48	1·03	·64	2·08	1·12	2·10

TABLE IV.—COMPOSITION of PURE LINSEED-CAKES, comparatively poor in ALBUMINOUS COMPOUNDS.

	American Cakes made from Bombay Linseed.			English Cakes.		
Moisture	11·98	9·92	10·46	11·28	12·78	14·24
Oil	12·14	9·88	10·15	10·35	11·20	12·34
* Albuminous compounds (flesh-forming matters)	25·12	23·25	24·05	23.50	24·93	23.93
Mucilage, sugar, and digestible fibre	31·01	35·46	36·86	35·51	31·51	28·53
Woody fibre (cellulose) ..	11·74	13·73	10·84	11·80	12·66	14·60
† Mineral matter (ash) ..	8·01	7·76	7·64	7·56	6·92	6·36
	100·00	100·00	100·00	100·00	100·00	100·00
* Containing nitrogen ..	4·02	3·72	3·85	3·76	3·99	3·83
† Containing sand	2·66	2·45	2·48	2·32	1·96	1·64

approximation to the average composition of a pure linseed-cake, it follows by no means that the cake is really such. I may mention at once that I have analysed farinaceous and mixed linseed-cakes, possessing by no means the qualities for which pure linseed-cake is justly held in high esteem, which had the same proximate percentic composition as pure linseed-cake of good quality.

Generally speaking, cake from St. Petersburg or Riga linseed is richer in albuminous compounds than that made from Bombay linseed. Cakes made from Baltic seed have a darker colour than cakes made from Bombay seed. Some of the finest descriptions of linseed-cake which ever passed through my hands were made from Baltic seed.

Cakes made from Bombay linseed are of a light-brown colour, and as a rule do not get so gelatinous as cakes which are made from fine Baltic seed. In Bombay linseed-cakes the form of the seed generally is more plainly visible than in cakes made from other kinds of linseed, Bombay seed being larger and having a coarser husk than most other kinds.

A good many American cakes are made from Bombay linseed.

The question is often asked—Is American cake better than, or not so good as, pure English linseed-cake? In reply to this question I would answer that, as a rule, the bulk of American cake is better than the majority of linseed-cakes that are manufactured in England and sold as genuine linseed-cakes. Pure English linseed-cake, as regards quality, however, can compete successfully with the best American barrel-cake, or any other kind of cake, no matter where it is produced.

The best American cake, as is well known, is shipped in barrels, care being taken to dry the cake thoroughly before it is packed. In consequence of the care which is taken, by several exporters of cake in America, in drying the cake and sending it over to England in barrels instead of packing it in bags, the cake is not so liable to become damaged or to heat on its passage—and therefore arrives in a fresh, dry, and excellent condition, which no doubt is the main reason why American barrel-cake fetches a higher price in the market than bag cake. If the cake is shipped too fresh, and not thoroughly dried, it is very apt to heat on its passage, to lose its fine flavour, and to turn sour or mouldy. Sour or mouldy cakes are always inferior in feeding quality, and if the mouldiness is very marked it is undesirable to use the cake for feeding purposes, for experience has shown that such cakes may do injury to animals. American bag-cake occasionally arrives in a bad condition, and has to be sold at a low price. Formerly, American linseed-cake was much richer in oil than it has been of late years, since the introduction into America of improved machinery for crushing the seed.

The oil unquestionably is the most valuable constituent of oil-cakes, and hence cakes that have been pressed very hard are not so valuable for feeding purposes as cakes to which a more moderate pressure has been applied. In the making of thin cakes the oil can be more thoroughly squeezed out of the seed than in the manufacture of thick cakes, and hence thin cakes, as a rule, are poorer in oil than thick.

Marseilles cakes are usually made from clean linseed, but, generally speaking, Marseilles cake is very hard pressed, and consequently rather deficient in oil. This description of oil-cake, however, keeps well, and when finely broken up by a cake-crusher answers extremely well for store cattle.

Hungarian and Neapolitan linseed-cakes often contain rather a larger proportion of wild oats and other cereal grains than should be present in pure linseed-cake, but as their price is lower than good English or American cakes, and their condition generally is good, they have been found economical and useful by the stock farmer.

II. Materials used in the Manufacture of mixed or compound Feeding-Cakes, and the Composition, Structure, and Properties of various substances employed for Adulterating Linseed-Cake.

The substances which are used in the production of compound feeding-cake or for adulterating linseed-cake are very numerous, as is shown by the following lists of substances which have come under my personal observation.

List of Adulterating Materials.—Rape-cake, ground or earth-nut-cake, earth-nut-husks, decorticated and undecorticated cotton-cake, beech-nut-cake, hempseed-cake, cocoa-nut-cake, cocoa-nut fibre, cocoa-cake, palm-nut-cake, palm-kernel-cake, palm-kernel refuse, Niger-seed-cake, sesamé or ·teal-seed-cake, poppy-cake, castor-oil-cake, bassia-cake, curcas-cake, indigo-seed-cake, olive-cake, siftings-cake, carob-beans, acorns, rice-meal, rice-shudes (husks), oat-shudes, barley-shudes, bran and pollard, dari-meal, flax-chaff, rye, maize, and sawdust.

1. *Rape-Cake.*—Rape-cake, when free from mustard, is a good feeding cake, and therefore largely employed in the manufacture of compound cakes. The best kind is green German rape or Rübsen-cake. Indian rape-cake generally is contaminated with so much wild mustard or charlock (*Sinapis arvensis*), that it is not safe to feed animals upon it. Several actions having been

tried in our law-courts in which the plaintiffs obtained verdicts for damages caused by feeding cattle upon cake which turned out to be Indian rape-cake, it is now seldom sold for feeding purposes, but is either bought for manuring purposes, or employed for adulterating linseed-cake or preparing mixed feeding-cakes.

The best rape-cake imparts a turnip-like flavour to the linseed-cake with which it is mixed, and for that reason alone reduces the practical value of it.

From a large number of analyses I select the following characteristic ones of three samples of rape-cake:—

TABLE V.—COMPOSITION of Three Samples of RAPE-CAKE.

	No. 1. English Rape-cake.	No. 2. Green German Rape-cake.	No. 3. Indian Rape-cake.
Moisture	9·14	10·82	12·07
Oil	10·84	8·72	10·31
* Albuminous compounds (flesh-forming matters)	28·31	33·81	34·12
Mucilage, sugar, and digestible fibre	25·84	28·05	29·15
Woody fibre (cellulose)	11·16	11·49	7·38
† Mineral matter	14·71	7·10	6·97
	100·00	100·00	100·00
* Containing nitrogen	4·53	5·41	5·46
† Containing sand	6·15	·52	·75

No. I. represents the composition of a sample of English rape-cake, which contained some mustard, and was evidently made from dirty seed, as it yielded over 6 per cent. of sand.

No. II. shows the composition of an excellent sample of green German rape-cake. It will be seen that this cake is fully as rich in nitrogenous (flesh forming) matters as the best linseed-cake, but is poorer in oil.

No. III. resembles in composition No. II. This Indian rape-cake was given in moderate quantity to a number of store cattle. Most of the animals, fortunately, would not touch it, but of those who partook of it, 3 died and others suffered more or less from the effects of the irritating essential oil of mustard. From a $\frac{1}{4}$ lb. of cake I obtained enough essential oil of mustard to convince me that half a cake of it, if not a smaller quantity, might kill a bullock.

2. *Ground-nut or Earth-nut Cake.*—Ground-nut or earth-nut

cake, or arachis-cake, as it is also called, is largely employed for adulterating linseed-cake. There are two kinds—the decorticated and undecorticated cake. The former is a dirty-white looking cake, the latter is light-brown coloured and shows a good many husks, the peculiar structure of which can be readily identified with a low power under the microscope. The following analyses fairly represent the average composition of the decorticated and whole-seed-cake:—

TABLE VI.—COMPOSITION OF GROUND-NUT OR EARTH-NUT CAKE.

	Decorticated.	Undecorticated.
Moisture	9·26	8·10
Oil	5·58	8·76
* Albuminous compounds (flesh-forming matter)	43·43	30·50
Mucilage, sugar, and digestible fibre	31·39	27·78
Woody fibre (cellulose)	5·18	19·12
Mineral matters (ash)	5·16	5·74
	100·00	100·00
* Containing nitrogen	6·95	4·88

Ground-nut or earth-nut cake is made from the seed of *Arachis hypogæa,* a pea-like plant, a native of Africa, now being extensively cultivated in many quarters of the globe for the sake of the sweet almond-like oil which is contained in its seed. The arachis or earth-nut partakes of the nature of the pea or bean of our own country, and has the singular habit of ripening its fruit or seed-pod underground. When the yellow flower has withered and the seed becomes fertilized, the bare stem of the plant grows rapidly in a curved manner towards the soil, which it gradually penetrates to a depth of several inches. In this obscure position the germ of the future seed grows and ripens. When mature the so-called earth-nut appears as a pale yellow-coloured oblong pod, sometimes contracted in the middle, and containing generally two seeds of the size of a small almond. The kernel is surrounded by a thin reddish-brown cuticle and is incased in a shell, which, in a dry state, has a wrinkled appearance, and possesses little feeding value, as it consists principally of woody fibre. The kernel is full of oil, and when fresh is as nice and sweet as an almond.

Arachis-nuts or peas are considered a valuable article of food in the tropical parts of Africa, America, and Asia. The plant is grown in many parts of the globe, notably in China, Ceylon, and other parts of India, in South Carolina, and the Isles of the Malayan Archipelago. It is also cultivated in Jamaica, where it is called pindar-nut. The seed furnishes from 40 to 45 per cent. of a pale-yellow oil, which is used as food and for burning in lamps.

Although earth-nut-cake is produced in very large quantities, and freely imported into England, it is seldom seen in the markets frequented by farmers, and is chiefly sold to cake-makers, who use it for adulterating linseed-cake.

The undecorticated cake contains nearly 20 per cent. of indigestible woody fibre, but, nevertheless, is rich in albuminous (nitrogenous) compounds, in which also the decorticated cake abounds. Both descriptions, on the other hand, are usually poor in oil. On account of the large percentage of nitrogenous compounds in earth-nut-cake, it is a favourite article with cake-makers for raising the percentage of nitrogen in linseed-cakes adulterated with starchy mill-refuse and other materials poor in nitrogen, to about the same level in which the nitrogenous constituents occur in pure linseed-cake.

The appended woodcut (Fig. 12) shows the earth-nut in natural size and a portion of the husk magnified. Under a higher power a section of earth-nut presents the appearance delineated in Fig. 13 :—

Fig. 12.—*Exterior of Earth-Nut.*

× 70 Diameters.

Fig. 13.—*Section of Earth-Nut.*

× 195 Diameters.

A. Cuticle. C. Spiral vessels.
B. Fibrous structure. D. Oil cells.

In connection with earth-nut-cake the subjoined analysis of earth-nut husks, composed chiefly of the light and reddish brown coloured cuticle surrounding the white kernel, may be given. They were sent to me not long ago, with the request to determine their feeding value :—

Composition of Ground or Earth-nut Husks.

Moisture	6·54
Oil	20·37
* Albuminous compounds (flesh-forming matters) ..	15·18
Mucilage, gum, and digestible fibre	30·39
Woody fibre (cellulose)	19·98
† Mineral matter (ash)	7·54
	100·00
* Containing nitrogen	2·43
† Containing sand	3·34

It will be seen that this refuse material contained rather more than 20 per cent. of oil, and in round numbers 15 per cent. of albuminous compounds, and therefore possessed valuable feeding properties.

3. *Cotton-Cake.*—The accompanying woodcut (Fig. 14) represents the appearance of cotton-seed under the microscope. Cotton-seed can be readily identified by the reddish-brown colour and peculiar structure of its husks.

Fig. 14.—*Cotton-seed, external coat, with fibres.*

× 140 Diameters.

Undecorticated cotton-cake is full of husks, inasmuch as most samples of cotton-seed contain over 40 per cent. and some rather more than 50 per cent. of husk. It has a greenish colour when fresh, and turns brown when the cake is kept for some time. Decorticated cotton-cake is made from the shelled seed or kernel, which varies in size in different samples, and is seldom larger than a large raisin pip.

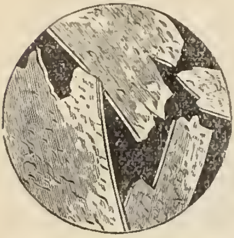
The following average analyses show that decorticated cotton-cake is very rich in albuminous compounds, in which respect it closely resembles decorticated earth-nut-cake. It differs from the latter by being much richer in oil, and on the whole is preferable to earth-nut-cake as a feeding material:—

Table VII.—Composition of Decorticated and Whole-seed Cotton-Cake.

	Decorticated.	Undecorticated.
Moisture	9·28	11·46
Oil	16·05	6·07
* Albuminous compounds (flesh-forming matters) ..	41·25	22·94
Mucilage, sugar, and digestible fibre	16·45	32·52
Woody fibre (cellulose)	8·92	20·99
Mineral matter (ash)	8·05	6·02
	100·00	100·00
* Containing nitrogen	6·58	3·67

4. *Beech-nut-Cake.*—Beech-nut-cake is poor in oil and albuminous compounds, and abounds in the husk, a representation of which under the microscope is here given.

Fig. 15. — *External layer of Beech-nut husks.*



× 70 Diameters.

A sample of beech-nut-cake on analysis gave the following result:—

Composition of Beech-nut-Cake.

Moisture	11·44
Oil	5·22
* Albuminous compounds (flesh-forming matter)	18·81
Mucilage, sugar, and digestible fibre	36·17
Woody fibre (cellulose)	23·52
† Mineral matter (ash)	4·84
	100·00
* Containing nitrogen	3·01
† Containing sand	·62

I have repeatedly found beech-nut-cake in adulterated linseed-cake.

The husks of beech-nuts contain a volatile narcotic principle called fagin, which is said to be the cause of the poisonous effects that are occasionally observed when beech-nut-cake is given to horses and cattle.

5. *Hemp-Cake.*—This cake is wholesome and nutritious, and notwithstanding a high percentage of woody fibre (due to the hard, shining shell of hemp-seed), it is fully as rich in nitrogen as the best linseed-cake:—

Composition of Hemp-Cake.

Moisture	11·59
Oil	7·23
* Albuminous compounds (flesh-forming matters) ..	33·50
Mucilage, sugar, and digestible fibre	15·56
Woody fibre (cellulose)	23·74
† Mineral matter (ash)	8·38
	100·00
* Containing nitrogen	5·36
† Containing sand	2·14

I have found hemp-seed only on two or three occasions in adulterated linseed-cakes.

6. *Cocoa-nut-Cake* (*Cocos nucifera*).—Cocoa-nut-cake, or poonac, or the press refuse from the manufacture of cocoa-nut oil, is a whitish-looking cake, interspersed with particles to which the dark reddish brown and black epidermis of the cocoa-nut kernel adheres.

It possesses the characteristic taste and smell of cocoa-nut oil, and frequently the oil left in the cake is rancid.

It is occasionally imported into England, and employed for adulterating oil-cake.

A sample of cocoa-nut cake, as analysed by me, gave the following result:—

Composition of Cocoa-nut-Cake.

Moisture	8·97
Oil	11·44
* Albuminous compounds (flesh-forming matters) ..	20·75
Gum, sugar, and digestible fibre	39·41
Woody fibre (cellulose)	14·27
† Mineral matter (ash)	5·16
	100·00
* Containing nitrogen	3·32
† Containing sand	·51

The structure of the external layer of cocoa-nut may be recognised under the microscope as indicated in the woodcut.

Fig. 16. — *External layer of Cocoa-Nut.*

× 70 Diameters.

7. *Cocoa-nut-Fibre.*—A far more objectionable ingredient of mixed or adulterated cakes is cocoa-nut-fibre refuse, which I have detected in several oil-cakes.

The accompanying analysis shows that cocoa-nut-fibre has no more nutritive value than woody fibre in the shape of sawdust:—

Table VIII.—Composition of refuse Cocoa-nut-Fibre.

		Calculated dry.
Moisture	71·51	..
Woody fibre (cellulose)	9·29	32·61
* Nitrogenous compounds	·36	1·26
Other organic compounds	15·81	55·49
† Mineral matter (ash)	3·03	10·64
	100·00	100·00
* Containing nitrogen	·058	·23
† Containing sand	·77	2·70

In a perfectly dry state, cocoa-nut-fibre refuse, it will be seen, contains only ·23 of nitrogen, and consists almost entirely of woody fibre and brown humus-like substances, similar to the brown humus in peat.

8. *Cocoa-Cake.*—The fruit of *Theobroma Cacao*, or cocoa-bean, is encased in an outer shell, which is separated from the kernel by gentle roasting. The shelled beans, or cocoa-nibs, are ground and manufactured into cocoa powder or chocolate, whilst the outer shell, with fragments of the kernel, on pressure yields cocoa-butter and cocoa-cake.

A sample submitted to me for analysis produced the following results :—

Composition of Cocoa-Cake (Theobroma Cacao).

Moisture	14·95
Oil	8·02
* Albuminous compounds	19·87
Woody fibre	18·26
Mucilage, sugar, and digestible fibre	32·46
Mineral matter	6·44
	100·00
* Containing nitrogen	3·18

Cocoa-cake has a chocolate-brown colour, and by no means an unpleasant taste or smell. Cattle like it, and it is a wholesome food, but, as the preceding figures show, much inferior in nutritive properties to linseed-cake.

A fragment of cocoa-cake placed under the microscope has the appearance represented in Fig. 17.

Fig. 17.—*Cocoa-Cake* (*Theobroma Cake.*)

× 70 Diameters.

9. *Palm-nut-Cake.*—The fleshy part surrounding the hard kernel of the oil-palm (*Elaïs Guinensis*) furnishes on the application of pressure the palm-oil of commerce, and the expressed pulp, which, under the name of palm-nut poonac or cake, occasionally finds its way into England, where it is used for adulterating oil-cake.

Some years ago a sample of this cake was sent to me for analysis from Hull by an oil-cake manufacturer. It was a dark-brown, hard-pressed cake, and had a nasty rancid taste and smell. It yielded on analysis the following results :—

Composition of Palm-nut-Cake.

Moisture	8·67
Oil	9·82
* Albuminous compounds (flesh-forming matters)	35·56
Mucilage, sugar, and digestible fibre	18·50
Woody fibre (cellulose)	17·05
† Mineral matter (ash)	10·40
	100·00
* Containing nitrogen	5·69
† Containing sand	2·61

In a fresh condition palm-nut-cake no doubt is a useful feeding material, for it contains a fair proportion of oil and is rich in albuminous compounds. The sample, however, submitted to me for examination had such an abominably rancid taste, that I felt convinced no animal would touch it, and I cannot but think that an oil-cake which is adulterated with old rancid palm-nut-cake is likely to do more harm than good to stock.

10. *Palm-nut-kernel-Cake.*—The hard oleaginous kernels of the palm-nut, pressed hot under powerful hydraulic presses, yield a white butter-like fat, and a press-cake, which varies in composition to some extent with the quality of the kernels and the amount of pressure to which they have been exposed.

For adulterating purposes, the hard-pressed foreign cake, which is chiefly made at Hamburg and Marseilles, is generally employed. The average composition of foreign palm-kernel-cake may be fairly represented as follows:—

Composition of Foreign Palm-kernel-Cake.

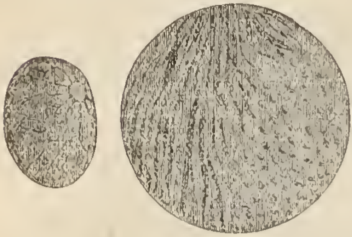
Moisture	11·91
Fatty matters	7·48
* Albuminous compounds	18·25
Starch, sugar, and digestible fibre	41·16
Woody fibre (cellulose)	17·90
Mineral matter (ash)	3·30
	100·00
* Containing nitrogen	2·92

Palm-kernel-cake has a light brown or dirt-coloured appearance, dotted with dark brown-coloured particles, to which the epidermal layers of the kernel adhere, and it contains also more or less of the hard, woody, black shell in which the kernel is encased.

The appended woodcut represents the appearance of palm-nut shelled kernels of the natural size, and of a fragment under the microscope.

It is a wholesome food enough, but its price—from 4*l.* 10*s.* to 5*l.* a ton—plainly shows that its nutritive properties are much inferior to oil-cake.

Fig. 18.—*Palm-nut-kernel.*



11. *Palm-nut-kernel-Shells.*—The palm-nut-kernels are surrounded by a thick brown shell consisting of woody or incrusting matter. These shells, reduced to powder, are occasionally to be found in considerable quantities in adulterated oil-cakes. Not long ago I received a sample for the purpose of ascertaining what amount of nutritive matter the shells contained, and found their composition as follows:—

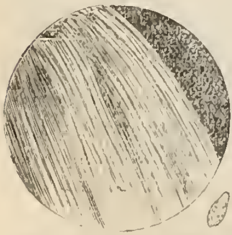
Composition of Palm-nut-kernel-Shells.

Moisture	10·12
Oil	1·51
* Albuminous compounds (flesh-forming matters) ..	2·93
Digestible fibre	16·37
Woody fibre	67·90
Mineral matters	1·17
	100·00
* Containing nitrogen	·47

It will be seen by the preceding figures that ground palm-kernel-shells are but little better for feeding purposes than black ebony-wood chips.

12. *Niger-seed or Gingelly-Cake.*—Niger or gingelly-cake is the pressed oily seed of the *Guizotea oleifera*, a small elongated black seed represented in the appended woodcut in its natural size, and as a fragment appears under the microscope. The cake has a dark-grey colour, showing here and there particles of the black, shining husk of the seed.

Fig. 19. — *External layer of Niger-seed.*



I found its composition to be as follows:—

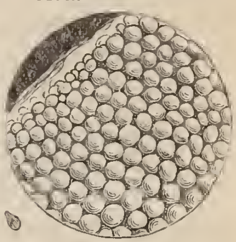
Composition of Gingelly, or Niger-seed-Cake.

Moisture	12·56
Oil	5·38
* Albuminous compounds (flesh-forming matters)	32·81
Mucilage, sugar, and digestible fibre	20·31
Woody fibre (cellulose)	21·08
† Mineral matter (ash)	7·86
	100·00
* Containing nitrogen	5·25
† Containing sand	1·20

Niger-cake, it will be seen, is poor in oil; and contains much woody fibre, but gives as high a percentage of albuminous compounds as occurs in genuine linseed-cake. It is largely used for adulterating the latter.

13. *Sesamé or Teel-Cake.*—There are several species of sesamé, which are annual plants, natives of the East Indies, and cultivated in the East for the sake of their oleaginous seeds. *Sesamé orientale* is the common sort. Sesamé-seed is about the same size as a large grain of white mustard; it is a flat, cordate-shaped seed, and either light or dark coloured.

Fig. 20. — *External layer of Sesamé-seed.*



A fragment of the husk of Sesamé-seed exhibits under the microscope the structure shown in Fig. 20.

A sample of sesamé-cake on analysis yielded the following results:—

Composition of Sesamé-Cake.

Moisture	8·06
Oil	11·34
* Albuminous compounds (flesh-forming matters)	36·87
Mucilage, sugar, and digestible fibre	25·05
Woody fibre (cellulose)	8·14
Mineral matter (ash)	10·54
	100·00
* Containing nitrogen	5·90

Sesamé-cake is rich in albuminous compounds, and contains as much oil as good linseed-cake.

Teel-oil is much used both for cooking purposes and burning in Egypt, India, China, and Japan, and may be kept for many years without becoming rancid. The press-cake, usually retaining from 10 to 12 per cent. of oil, has also an agreeable taste, and may be kept sweet for a long period when stored in a dry place.

14. *Olive Press-Cake.*—In preparing olive-oil a press-cake is obtained, which consists of the pressed fleshy part of the olive (*Olea Europæa*), and the hard, crushed, oblong, olive-stones. The quality and composition of olive-cake varies a good deal with the degree of pressure that has been applied in obtaining olive-oil, and the relative proportions of the fleshy part and the stones in the residual press-cake.

This will appear from the subjoined analyses of two samples of this kind of refuse-cake:—

TABLE IX.—COMPOSITION of two samples of OLIVE-CAKE.

	No. 1.	No. 2.
Moisture	17·11	13·41
Oil	11·29	3·10
* Albuminous compounds (flesh-forming matters) ..	3·50	6·01
Mucilage, sugar, and digestible fibre	27·18	30·66
Woody fibre (cellulose)	33·19	38·24
Mineral matters (ash)	7·73	8·58
	100·00	100·00
* Containing nitrogen	·56	·96

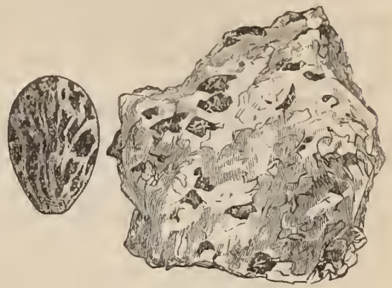
The first sample is much richer in oil than the second, which, as shown by the larger proportion of woody fibre, was made principally from olive-stones. Olive-cake of the character of the second sample is a poor feeding material, for it contains but little oil and albuminous substances, and abounds in woody fibre, due to the presence of a large proportion of the hard woody portion of olive-stones.

The woody shells of olive-stones, which are as hard as cherry-stones, frequently occur in olive press-cake in a very coarsely crushed state. In that condition they are indigestible, and liable to cause constipation and subsequent inflammation of the bowels of the animals that are fed upon cake like the second sample. Olive-cake has a dark-brown colour, and usually is full of hard bits of broken shell of the stones. It is used in the manufacture of certain compound feeding-cakes, and occasionally employed for adulterating oil-cakes.

15. *Castor-oil-Cake.*—The seeds of the castor-oil bean (*Ricinus communis*), represented in the accompanying woodcut, are readily distinguished from other seeds by their size, shape,

and the peculiar striated appearance of the shiny, brittle, and modelled-looking seed-shell. The shelled seed is white, and full of a purgative oil.

Fig. 21.—*Castor-oil-bean.*



Castor-oil-cake, or castor-poonac, is a powerful purgative medicine, and, when mixed with linseed-cake, imparts poisonous properties to it.

It is very rich in nitrogen, as will be seen by the following analysis of a sample lately analysed by me :—

Composition of Castor-oil-Cake, or Castor-Poonac.

Moisture	9·95
* Organic matter	81·07
Phosphate of lime and magnesia	4·49
† Alkaline salts	1·80
Sand	2·69
	100·00
* Containing nitrogen	8·69
Equal to ammonia	10·55
† Containing phosphoric acid	·06
Equal to tribasic phosphate of lime	·13

Castor-cake, on account of the large amount of nitrogenous matters which it contains, is a powerful fertilizer, but should never be mixed with feeding-cakes.

I have repeatedly found castor-cake in linseed-cake, which had been sent to me for examination on account of the injury the adulterated cake had done to cattle. Its presence in oilcake can only be recognized under the microscope by the peculiar appearance and structure of fragments of the seed-shells.

16. *Bassia-Cake.*—The seeds of several species of Bassia indigenous to India, yield solid oils or fats.

Fig. 22.—*Bassia-seed.*

Mahower (*Bassia latifolia*) is common in most parts of the Bengal Presidency. The seed-kernels have a light reddish-brown colour; they are surrounded by a yellow-coloured, bright-looking thin leathery seed-shell, and are about the size of an acorn.

The appended woodcut illustrates the appearance of a Bassia-seed of the natural size, and a fragment under the microscope.

The solid fat, properly refined, has no disagreeable taste, but the pressed cake, and especially the yellow husk of the seed, have an intensely acrid and bitter taste, and are altogether unfit for feeding purposes.

Recent analyses of Bassia-nuts and cake—both in all probability derived from Bassia latifolia—gave me the following results:—

Composition of Indian Bassia-nut-Cake.

Moisture	13·54
* Organic matter	80·79
Phosphates	1·43
Magnesia, &c.	3·63
Sand	·61
	100·00
* Containing nitrogen	2·73
Equal to ammonia	3·31

Composition of Bassia-nuts.

Moisture	6·54
Oil	40·40
* Albuminous compounds (flesh-forming matters)	9·31
Mucilage, sugar, and digestible fibre	32·41
Woody fibre (cellulose)	8·24
Mineral matter	3·10
	100·00
* Containing nitrogen	1·49

Since I made the preceding analyses, I have recognized Bassia-cake in adulterated rape-cake, but have not yet met with it in linseed-cake.

17. *Indigo-seed-Cake.*—A few years ago I received for examination a cake which was described to me as indigo-seed-cake.

It had a yellowish-brown colour, a nasty slightly bitter taste, became very gelatinous when mixed in a powdered state with water, and on analysis yielded the following results:—

Composition of Indigo-seed Cake.

Moisture	11·91
Oil	4·01
* Albuminous compounds (flesh-forming matters)	18·15
Mucilage, sugar, and digestible fibre	47·96
Woody fibre (cellulose)	11·88
† Mineral matter	6·09
	100·00
* Containing nitrogen	2·90
† Containing sand	·99

Indigo-seed-cake, it appears from the preceding analysis, is very poor in oil, nor does it contain a high percentage of albuminous compounds. Apart from its disagreeable taste, which in a great measure spoils the fine flavour of linseed-cake, with which it is occasionally mixed, it does not possess a high feeding value.

This cake was sent to me for examination by an oil-crusher, and but for this circumstance I probably should not have been able to detect Indigo-seed in a sample of linseed-cake, which was sent to me for examination soon after I reported that the indigo seed-cake was not poisonous, but a poor and disagreeable tasting cake. Notwithstanding the unfavourable report I had given, indigo seed-cake appears to have found its way into linseed-cake mills.

18. *Siftings, or Screenings-Cake.*—Dirty linseed, as already fully described in the preceding pages, contains a host of small weed-seeds, dirt, and similar impurities. In mills in which pure linseed-cake is made, these impurities are removed from linseed by screening or sifting. The siftings or screenings, however, are not thrown aside, for they possess a commercial value of their own, and fetch a much higher price than they are worth intrinsically, inasmuch as they are either employed for mixing with fairly clean samples of linseed, and producing 2nd and 3rd quality samples of "genuine linseed as imported," or are pressed into cake.

A sample of siftings-cake, on analysis in my laboratory, yielded the following results:—

Composition of Siftings, or Screenings-Cake.

Moisture	10·57
Oil	6·45
*Albuminous compounds (flesh-forming matter)	18·44
Starch, mucilage, and digestible fibre	35·94
Woody fibre (cellulose)	14·13
†Mineral matter (ash)	14·47
	100·00
* Containing nitrogen	2·95
† Containing sand	7·37

Siftings-cake, as shown by the preceding analytical result, contains much sand, and is one of the most abominable compounds that can be incorporated with feeding stuffs. It appears to be a regular article of commerce; and, although it contains hardly any linseed, and generally is full of wild mustard, and for that reason decidedly injurious to cattle, it is occasionally sold at a low price as linseed-cake.

Not long ago a farmer sent me a so-called linseed-cake, which he reported to me had killed several of his cattle, and proved more or less injurious to the rest. On examination I recognized the cake at once as a siftings-cake containing scarcely any linseed.

19. *Poppy-Cake.*—There are two kinds of poppy-cake—one a whitish-looking cake made from white poppy, and the other a brownish-coloured cake made from ordinary poppy-seed.

When fresh, poppy-cake is a useful feeding-cake. Poppy-oil, however, rapidly turns rancid, especially under the influence of heat. Hot pressed poppy-cake for this reason frequently has a rancid taste. On keeping for any length of time, such cake becomes so rancid that cattle refuse to eat it. Having become unsaleable as a feeding-cake, it is exported into England from Belgium and other parts of the Continent where it is chiefly produced. It is ground fine, and together with other materials manufactured into linseed-cake.

A sample of poppy-cake analysed by me yielded the following results :—

Composition of Poppy-Cake.

Moisture	11·63
Oil	5·75
* Albuminous compounds (flesh-forming matters) ..	31·46
Non-nitrogenous substances	38·18
† Mineral matter (ash)	12·98
	100·00

* Containing nitrogen	5·11
† Containing sand	7·58

Poppy-cake is usually poor in oil, and as poppy is generally grown on light sandy soils, in harvesting the seed it frequently becomes contaminated with fine white sand, which, as shown in the preceding analysis, thus finds its way into the cake.

20. *Curcas-Cake.*—Curcas beans are the oily seeds of a small tropical tree (*Jatropha Curcas*) which flourishes especially in the Cape de Verde Islands, from whence we receive the largest supply of this oleaginous seed. The beans are of about the same size as acorns. The white kernel is surrounded by a brown-coloured thick seed-shell, which has the distinctive structure represented in the accompanying wood-cut (Fig. 23).

Fig. 23.—*Curcas-bean.*

The oil contained in these beans is a most violent purgative, for 10 to 12 drops are sufficient to produce all the effect of a powerful dose of a drastic medicine, and only a few beans have to be swallowed to kill a strong healthy man. Curcas-cake, or the residue from the oil-presses, usually contains from 9 to 11 per cent. of oil, and of course is extremely poisonous, and only fit to be used as a manure.

In the course of my experience I have met with about half a dozen instances in which cake, sold as pure linseed-cake, was adulterated with curcas beans, which, although present in apparently but small quantities, nevertheless rendered the cake poisonous. Of all the materials which get mixed up with linseed-cake, either through culpable carelessness or ignorant cupidity, curcas-cake is the most poisonous matter with which I have become acquainted.

21. *Locust or Carob-Beans.*—Carob or locust-beans, or St. John's bread, are the seed-pods of the locust-tree (*Ceratonia Siliqua*). Dried and ground into meal, they form a favourite material for manufacturing cattle-food and compound cakes, and for adulterating linseed-cakes.

Locust-meal, as will be seen by the following analyses of three samples analysed in my laboratory, contains in round numbers fully half its weight of sugar, and in consequence is very palatable and much liked by horses, sheep, and cattle.

TABLE X.—COMPOSITION of LOCUST of CAROB-BEAN-MEAL.

	No. 1.	No. 2.	No. 3.
Moisture	17·11	12·61	14·22
Oil	1·19	1·08	·96
Sugar	51·42	50·30	54·07
Mucilage and digestible fibre	13·75	20·13	14·41
*Albuminous compounds	7·50	5·87	7·72
Woody fibre	6·01	7·14	5·88
Mineral matter (ash)	3·02	2·87	2·74
	100·00	100·00	100·00
* Containing nitrogen	1·20	·94	1·25

In addition to the constituents mentioned in the preceding analyses, carob-beans contain variable quantities of butyric acid, which impart to the crushed beans or meal a peculiar flavour. This meal is deficient in albuminous compounds, and for this reason it is desirable not to feed cattle too freely upon it, but to mix it with peas or bean-meal, or decorticated cotton-cake, or similar feeding materials rich in nitrogenous compounds.

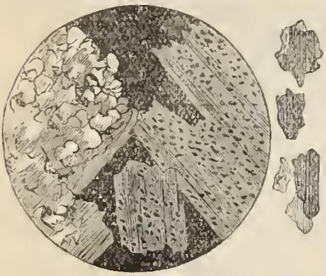
Locust-beans are cheap at the price at which they can usually be bought in the market, and this is another reason why they are largely employed by makers of cattle foods.

There is, however, a drawback to the use of locust-beans in the manufacture of compound cakes. Locust-meal, it appears from the preceding analyses, contains in round numbers from 50 to 54 per cent. of fruit and crystallizable sugar. In consequence of this large proportion of sugary constituents the meal is very hygroscopic; and cakes into the composition of which locust-meal largely enters are very liable to attract moisture, to become soft, and subsequently to turn mouldy. In a mouldy condition feeding-cakes, it is to be feared, often do more injury than most people are aware of.

Locust-meal, on account of its sweet taste, is frequently employed by cake-mixers to conceal the presence of bitter or unpalatable cheap materials in so-called linseed-cake.

Its presence in adulterated oilcakes may be recognized by the butyric-acid smell which such cakes emit; by determining the amount of sugar, which is abnormally large in oilcakes adulterated with carob-beans; and lastly by the shiny appearance and structure of the cuticle of carob-beans under the microscope, as will be seen by the appended microscopic representation of a fragment of the locust bean-pod.

Fig. 24.—*Cuticle of Carob-bean.*



22. *Acorns.*—In seasons of plenty, dried and ground acorns are much more profitably sold as linseed-cake than under their legitimate name. I have in my collection a cake branded "Pure," which was sold as linseed-cake, and in which I found considerable quantities of ground acorns.

In a fine specimen of acorns I found the proportion of husks and decorticated nuts as follows:—

Husks	139·05
Decorticated acorns	860·95
	1000·00

The decorticated acorns had the following composition:—

Composition of Decorticated Acorns.

Moisture	40·88
Oil	2·64
* Albuminous compounds	4·39
Starch, sugar, and digestible fibre	46·74
Woody fibre	3·94
Mineral matter	1·41
	100·00

* Containing nitrogen .. .. ·703

Acorns are rich in starch, and in addition to the constituents enumerated in the preceding analysis, contain tannic and gallic acid. Their presence in linseed-cake can be recognised by the appearance of fragments of acorn-shells under the microscope, and further by making a cold infusion of the powdered cake in water. If a few drops of perchloride of iron are added to the clear and filtered watery solution, the presence of the tannic acid in acorns is at once revealed by the black inky colour which the iron salt produces with it.

23. *Dari, or Dhoora Grain.*—Under the names of Durra, Doora, Dhoora, Juwaree, Joudha, and Dari, the seed of the *Andropogon Sorghum* forms an article of diet in India, Arabia, Turkey, the Levant, and other parts of the world; it is occasionally imported into England and sold at a cheap rate,

Fig. 25.—*Husk of Acorns.*

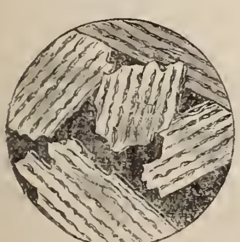


Fig. 26.—*Skins of Dari.*

is a capital and cheap food for poultry, and is also used for adulterating linseed-cakes. When analysed I found it to consist of—

Composition of Dari Grain.

Moisture	13·14
Oil	3·30
* Albuminous compounds (flesh-forming matters)	7·75
Starch, sugar, and digestible fibre	68·45
Woody fibre (cellulose)	4·72
† Mineral matter	2·64
	100·00
* Containing nitrogen	1·24
† Containing sand	·88
Earthy phosphates	·81
Alkaline salts	·95
Containing phosphoric acid	·38

This analysis shows that Dari-seed is rich in starch, and contains an appreciable quantity of oil. It is poorer in albuminous compounds than barley-meal, and scarcely as valuable for feeding purposes.

24. *Rice-Meal.*—In preparing rice for the market various descriptions of rice-meal are obtained, differing in quality and nutritive value according to the relative proportion of the outer husks (rice-shudes), and the broken grain of rice which they may contain.

The following analysis fairly represents the composition of a sample of rice-meal of fair average quality:—

Composition of Rice-Meal.

Moisture	8·67
Oil	7·59
* Albuminous compounds (flesh-forming matters)	7·75
Mucilage, sugar, and digestible fibre	39·98
Woody fibre (cellulose)	21·98
† Mineral matter (ash)	14·03
	100·00
* Containing nitrogen	1·24
† Containing silica	9·41

Rice-meal is a favourite material for adulterating linseed-cakes. It is cheap, and contains, as shown in the preceding analysis, a considerable quantity of oil, and is a useful fattening meal, but of course far too dear when sold in the shape of oilcake.

25. *Rice-Shudes* (husks).—The chaff or outer husks of rice are much inferior in feeding value to rice-meal; in a finely ground state they are frequently found in inferior and adulterated oilcakes.

On analysis, I found the composition of rice-shudes to be as follows:—

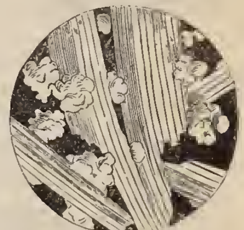
Composition of Rice-Shudes (Husks).

Moisture	9·80
Oil	1·10
* Albuminous compounds (flesh-forming matters) ..	4·18
Starch, mucilage, and digestible fibre	44·94
Woody fibre (cellulose)	26·80
† Mineral matters (ash)	13·18
	100·00
* Containing nitrogen	·67
† Containing silica	12·34

It will be seen that rice-shudes contain only a small quantity of oil and albuminous compounds, but much woody fibre; and that the mineral matter chiefly consists of silica, which forms the glaze of the rice-husks. They are worth about as much for feeding purposes as good oat or barley chaff.

Rice-husks may be recognised under the microscope by the structure represented in the following woodcut.

Fig. 27.—*Rice-husk.*



26. *Barley-Husks.* — Inferior adulterated oilcakes not unfrequently contain abundance of barley-husks, which are little more valuable than barley-straw.

27. *Oat-Shudes* (husks).—The outer husks of oats closely resemble oat-straw in composition, as the appended analysis clearly shows. They are obtained in the preparation of oatmeal, and sold largely to the oilcake-makers.

Composition of Oat-Shudes (Husks).

Moisture	11·98
Oil	·36
* Albuminous compounds (flesh-forming matters) ..	1·25
Mucilage, sugar, and digestible fibre	53·63
Woody fibre (cellulose)	28·48
† Mineral matter (ash)	4·30
	100·00
* Containing nitrogen	·20
† Containing soluble silica	3·64

28. *Bran and Pollard.*—Bran and pollard are perhaps more extensively used for adulterating oilcakes than any other material. Bran on an average contains in 100 parts:—

Composition of Bran.

Moisture	12·86
Oil	5·56
* Albuminous compounds (flesh-forming matters) ..	13·80
Starch, gum, and digestible fibre	50·17
Woody fibre (cellulose)	11·50
Mineral matter (ash)	6·11
	100·00
* Containing nitrogen	2·24

Fig. 28.—*Oat-husk.*

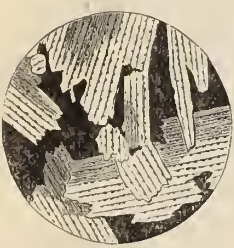


Fig. 29.—*Barley-husk.*

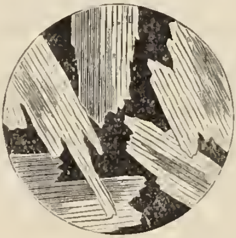


Fig. 30.—*Bran.*

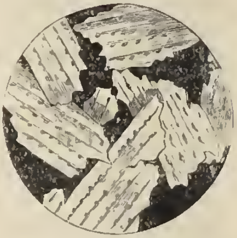
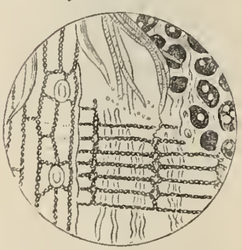


Fig. 31.—*Husks and skins of Oats.*

Fig. 32.—*Husks and skins of Barley.*

Fig. 33.—*Skins of Wheat.*



Bran contains a larger amount of fatty matters and nitrogenous compounds than the whole grain of wheat, and for this reason it constitutes a valuable refuse, which the makers of adulterated oilcake turn to a very profitable account. It can be readily detected in cakes by its appearance under the microscope.

The preceding woodcuts illustrate the appearance under the microscope of barley, oat, and wheat husks and skins.

29. *Flax-Chaff.*—The seed capsules in which linseed occurs, dried and ground fine, are used occasionally for adulterating oilcakes.

A sample of flax-chaff analysed in my laboratory was found to have the following composition :—

Composition of Flax-Chaff (the Seed-capsules of Linseed.)

Moisture	14·60
Oil	2·82
* Albuminous compounds (flesh-forming matters) ..	4·75
Gum, mucilage, and sugar	8·72
Digestible fibre	18·56
Woody fibre (cellulose)	43·12
Mineral matter (ash)	7·43
	100·00
* Containing nitrogen	·76

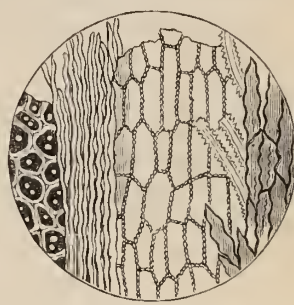
Flax-chaff contains more oil, and rather more albuminous matter, than the straw of cereals, and is more valuable for feeding purposes. However, on the whole, it is a cheap and bulky article of food which should never find its way into linseed-cake.

30. *Rye* is occasionally found in adulterated linseed-cake.

31. *Maize or Indian Corn* is another material which is employed for adulterating linseed-cake.

Fig. 34.—*Skin of Rye.*

Fig. 35.—*Skins of Maize.*



32. *Sawdust.*—In completing the enumeration of materials which I have actually found in oilcakes, I have to mention that in several instances pine and mahogany sawdust were detected.

III. Composition and Properties of Adulterated, Mixed, and Inferior Linseed-Cakes.

The foregoing description of the materials used in oil-mills, for the purpose of adulterating linseed-cakes, and for the manufacture of compound feeding-cakes, shows how great is the variety of substances which are actually used for the production of cheap and adulterated linseed-cake.

Some of the materials, which, like curcas-beans or castor-oil-cake, are downright poison, do not frequently occur, and generally get mixed up with feeding cakes through ignorance or carelessness; for it may be taken for granted that no oil-cake maker is likely, willingly, to mix with cake materials which he knows to be poisonous.

Thus, when the sweepings of seed-warehouses, or granaries and general provision stores, together with various broken cakes and similar cheap materials are pressed into compound cakes, it happens at times that poisonous materials are accidentally introduced into such cakes. I have myself picked out from broken linseed-cake and linseed-cake-dust sold for re-crushing, castor-oil-beans, resin, and gums having the appearance of scammony; and in dozens of instances I have found castor-cake in linseed-cake.

The following analyses of three poisonous cakes, in which I found castor-cake, are here introduced for the purpose of showing that although they were equally poisonous, and owed their prejudicial properties to the same poisonous ingredient, they widely differed in their proximate composition, and that the mere chemical analysis of a suspected cake does not necessarily throw light upon its true character:—

TABLE XI.—COMPOSITION of three samples of poisonous LINSEED-CAKE, containing CASTOR-OIL BEANS.

	No. 1.	No. 2.	No. 3.
Moisture	6·24	11·34	13·88
Oil	15·02	8·22	7·47
* Albuminous compounds (flesh-forming matters)	24·75	30·93	36·31
Mucilage, sugar, and digestible fibre	} 41·33	32·75	22·64
Woody fibre (cellulose)		9·09	12·02
† Mineral matter (ash)	12·66	7·67	7·68
	100·00	100·00	100·00
* Containing nitrogen	3·96	4·93	5·81
† Containing sand	6·42	2·20	2·52

A glance at the preceding analyses shows:—

1. That No. 1 was very dry, and No. 2 rather a damp cake, containing more than twice as much water as No. 1.

2. That the proportion of oil varied from 7½ to 15 per cent. in the three cakes.

3. That No. 1 was comparatively poor in nitrogenous compounds, whilst the cake under No. 3 was unusually rich in these compounds.

A comparison of the percentage composition of the poisonous cake marked No. 2, with that given in a preceding page for several pure linseed-cakes, further shows a close agreement in the proportions of the several constituents mentioned in the analysis.

Similar instances, if necessary, might be quoted in further illustration of the fact that a proximate analysis in itself is insufficient to determine whether a cake is poisonous, or a pure, or an adulterated linseed-cake. It must not be inferred, however, from this remark, that it is altogether useless to submit a cake to a proximate analysis, for in not a few cases such an analysis affords useful hints to the examiner, and supplies him with positive evidence that a cake is adulterated.

Thus linseed-cakes adulterated with ground-nut and cotton-cake, or rice-husks, olive-cake, cocoanut-fibre, and other materials abounding in woody matter, on analysis furnish a much higher percentage of woody fibre than occurs in genuine cake of fair average quality.

Again, if a cake is largely adulterated with starchy mill-refuse, its analysis generally shows a deficiency in oil and albuminous compounds, and by appropriate tests the presence of starch, which is not a normal constituent of linseed, can be demonstrated. Or if a cake is made from very dirty seed, or is mixed with ground plaster of Paris, which I might have mentioned in the list of adulterating materials, for I found ground plaster of Paris on several occasions in oil-cakes, the analysis of the adulterated cake will show an unusually high percentage of sand, or the presence of sulphate of lime (plaster of Paris) or other earthy or mineral matter that may be present in much larger quantities in the adulterating materials used in the manufacture of the cake than in genuine linseed-cake. Linseed-cakes which are adulterated with bran or pollard, or with rice-meal are generally poor in oil and albuminous compounds. This is seen in the following analysis of cakes, all adulterated with bran, pollard, and similar starchy mill refuse.

TABLE XII.—COMPOSITION of LINSEED-CAKES adulterated with BRAN, POLLARD, and RICE-MEAL.

	No. 1.	No. 2.	No. 3.	No. 4.
Moisture	13·32	9·92	13·52	12·12
Oil	9·26	9·88	9·02	8·27
*Albuminous compounds (flesh-forming matters	21·94	23·25	23·64	25·87
Starch, mucilage, and digestible fibre ..	38·46	35·46	33·87	31·37
Woody fibre (cellulose)	10·96	13·73	12·08	12·92
†Mineral matter (ash)	6·06	7·76	7·87	9·45
	100·00	100·00	100·00	100·00
* Containing nitrogen	3·51	3·72	3·76	4·14
† Containing sand..	1·64	2·45	3·43	3·37

The cakes No. 1 and No 2 were adulterated with bran and pollard, and Nos. 3 and 4 with rice-meal. All were poor in oil and in albuminous compounds.

The husk of rice contains much silica, and hence linseed-cake largely adulterated with rice-shudes or inferior rice-meal, on burning in a platina-dish, produces an ash which contains much silica. Cakes adulterated with cotton-cake, earth-nut-cake, hemp-cake, and other cakes made from seeds with a hard husk, contain more than an average proportion of woody fibre. In illustration of this I have selected from a large number of analyses of adulterated cakes the following:—

TABLE XIII.—COMPOSITION of LINSEED-CAKES adulterated with COTTON and EARTH-NUT CAKE, HEMP-CAKE, and OLIVE-CAKE.

	No. 1.	No. 2.	No. 3.	No. 4.
Moisture	11·54	10·18	9·45	10·76
Oil	10·14	7·61	13·39	8·60
* Albuminous compounds (flesh-forming matters	22·56	24·68	28·56	19·69
Mucilage, sugar, and digestible fibre ..	29·78	31·21	22·85	33·99
Woody fibre (cellulose)	20·70	19·88	20·30	18·84
† Mineral matter (ash)	5·28	6·44	5·45	8·12
	100·00	100·00	100·00	100·00
* Containing nitrogen	3·61	3·95	4·57	3·15
† Containing sand	·85	1·68	1·48	3·24

The cake marked No. 1 was largely adulterated with cotton-cake and earth-nut-cake. No. 2 was much adulterated with hemp-seed-cake and some cotton-cake. No. 3 was much adulterated with earth-nut-cake, bran, rice-meal, and a little cotton-cake. This cake was sold as best English linseed-cake, and the gentleman who sent it to me for analysis wrote as follows:—"I have reason to believe the cake contains some ingredient highly injurious to stock, as I have within the last five weeks lost thirty lambs which have been fed on it." The condition of the cake was not good, and it is more likely that it did injury to the lambs by reason of its bad condition, than on account of any positively poisonous ingredient which it may have contained and which I failed to detect.

No. 4 was a mixed linseed-cake, composed of linseed, carob-bean-meal, cotton-cake, and olive-cake.

Not long ago I received for examination a sample of cake, which was sold at a fair price as genuine linseed-cake, and which

I was informed had killed several beasts, and done serious injury to others. This cake on analysis yielded the following results:—

Moisture	10·42
Oil	8·92
* Albuminous compounds (flesh-forming matters) ..	17·25
Starch, mucilage, and digestible fibre	37·95
Woody fibre (cellulose)	17·70
† Mineral matter (ash)	7·76
	100·00
* Containing nitrogen	2·76
† Containing sand	2·85

It will be seen that this cake was deficient in oil, very poor in albuminous compounds, and richer in woody fibre than genuine linseed-cake. On further examination I found that it did not become gelatinous at all on digestion with distilled water, that it hardly contained any linseed, and was almost entirely composed of a host of weed-seeds like the seeds which I enumerated in a former page, when speaking of the nature of the seeds which constitute the screenings or siftings from linseed. In point of fact this cake was hardly better than the siftings-cake of which I have already given an analysis, and to which I would refer the reader for a comparison with the preceding analytical results.

We have here a practical illustration of the injurious properties of linseed-siftings, and the danger which the purchaser of cheap cakes (made from very foul linseed) runs of doing injury to his stock when he feeds them upon such cake.

Generally speaking, inferior or adulterated linseed-cakes do not become very gelatinous when mixed with water, and not unfrequently have an acid taste, and are destitute of the peculiar nice flavour which distinguishes pure linseed-cake.

Many farmers like cakes in which they can clearly recognise fragments of linseed; and they regard it as a proof of good quality if a cake presents to the eye some apparently uncrushed linseeds. It is not safe, however, to rely upon the visible presence of whole linseeds as a test of the good quality of a cake, for in apparently some of the worst samples a good many whole uncrushed linseeds are frequently visible. Oil-cake makers, aware of the habit of many farmers to look out for whole linseeds in cake, simply add a proportion of whole linseed to the mixture of cheap feeding materials which they intend to convert into linseed-cake, and by this means give it a character which some regard as an indication of genuineness.

IV. Remarks on the Causes which render Feeding-Cakes either decidedly Poisonous, or more or less Injurious to the Health of Animals.

Decidedly poisonous substances, as a rule, do not often occur in linseed-cake, and it is rather by accident or carelessness than by design that cakes become contaminated with poisonous ingredients. Besides curcas and castor-oil-beans, I have not found in linseed-cake any other decidedly injurious ingredient; in rape-cake, however, I may mention that black or wild mustard frequently occurs in so large a proportion as to render it quite unfit for feeding purposes.

As far as I know, castor-oil-beans are not crushed in England, which circumstance accounts for the fact that I have never found castor-beans in English linseed-cake. Castor-oil is principally produced in India, and to some extent also at Marseilles, and I have found castor-cake both in Bombay and Marseilles linseed-cake. In mills where both linseed and castor-oil beans are crushed, it occasionally happens that through the carelessness of the workmen, the stores of linseed in part get mixed up with some castor-oil-beans. In consequence of the partial admixture of the linseed with castor-oil-beans, the cake from the mixed seed is rendered more or less injurious, whilst the bulk made from linseed free from castor-oil-beans is perfectly wholesome. Under these circumstances the cakes shipped to England, probably in nine cases out of ten turn out to be wholesome, whilst, it may be, the tenth parcel from the same shipment is more or less contaminated with castor-bean-cake. The farmer who, unfortunately, is supplied with such a mixed lot, experiencing injury to his stock, then claims compensation for the damage done by the use of the cake, which he bought as genuine linseed-cake. In resisting the claims, the dealer who supplied the cake finds no difficulty in pointing out a number of customers who express themselves to be perfectly satisfied with the quality of the cake, which he can prove to have been delivered to them from the same cargo from which the cake alleged to be poisonous was sold. In this way disputes originate, which finally are brought into Court; trustworthy evidence is given by the plaintiff's witnesses, in proof of the poisonous character of the cake, and equally reliable witnesses on the defendant's part declare the same cake to have proved in practice perfectly wholesome and of excellent quality; and the bewildered jury find no little difficulty in agreeing upon a verdict. However, if the plaintiff would take the precaution to send the suspected cake to an analytical chemist or microscopist, well experienced in cake examinations, convincing evidence would be forthcoming in case the linseed-cake is really contaminated with castor-oil-beans, for the characteristic seed-shells of the beans can be detached without much trouble from the cake, and exhibited in Court.

In connection with oil-cake trials, in which the question has to be decided whether a cake is poisonous or unwholesome (trials in which I have been repeatedly engaged professionally), I may mention that not long ago four samples of linseed-cake were sent to me for examination by a dealer, who informed me he had good reason for supposing that some of the parcels represented by the samples were made up of sound, and others from the same cargo, of poisonous, linseed-cake. The supposition of the cake-merchant turned out to be correct, for in two of the samples I found the shells of castor-oil-beans, and in the two remaining cakes I could not detect a trace of castor-cake, or of any other deleterious substance.

As already stated, linseed and other feeding cakes have frequently been sent to me on account of the mischief which they were alleged to have done to cattle and sheep. I nevertheless could not detect any decidedly poisonous ingredient in the cakes. A review of the different cases which have from time to time been brought under my notice has forced upon my mind the conviction that certain cakes are injurious to the health of animals, although they do not contain any positively poisonous material which is amenable to chemical tests. As this is a subject of considerable interest to the breeder and fattener of stock, I may be allowed to give expression to my views on the matter at some length.

I observe, therefore, in the first place, that mouldy and heated feeding-cakes have frequently proved in practice to be more or less injurious to animals fed upon them in any considerable quantity. The instances in which very mouldy feeding-cakes have injured or killed cattle are too numerous to leave any room for doubt about the injurious properties of damaged mouldy linseed or other feeding-cakes. Indeed, all articles of food in a mouldy condition are more or less unwholesome. Damaged, fusty, or mouldy oats or wheat, mouldy flour and bread, in many cases, have done serious injury to men and animals fed upon them. A striking instance of poisoning with mouldy oats is recorded in the 'Veterinarian' for 1862. Professor Varnell's account of the particulars relating to the death of several horses from partaking of some deleterious oats brought under his notice by Mr. Mitchell, M.R.C.V.S., Leeds, and the experiments which the Professor subsequently made with some of the deleterious oats, are full of interest and worthy of careful perusal. But as the 'Veterinarian' may not be accessible to many, I take the liberty of quoting from that journal some of the particulars with which, as it appears to me, all stock-farmers should be acquainted.

"A gentleman in the neighbourhood of Leeds lost six horses in a very sudden manner. The veterinary surgeons engaged, viz., Messrs. John Mitchell, Dray, and Cuthbert were unanimous in their opinion that poison, in some form or other, was the cause of death, notwithstanding that no poison could be traced by the chemist who examined the contents of their stomachs and intestines. The oats, beans, &c., upon which the horses were fed, on analysis likewise proved to be free from poison.

However, three feeds of the suspected oats, given to a horse obtained for experiments, were found sufficient to produce death.

Mr. Mitchell, in speaking of the oats, writes to Professor Varnell:—"The oats, which were foreign ones, consisted originally of 12 quarters, of which about 5 quarters now remained; and with the exception of having a fusty smell, they presented nothing remarkable, nor did the bean-meal or bran, both of which had been purchased from a respectable dealer, and were unexceptionable in quality."

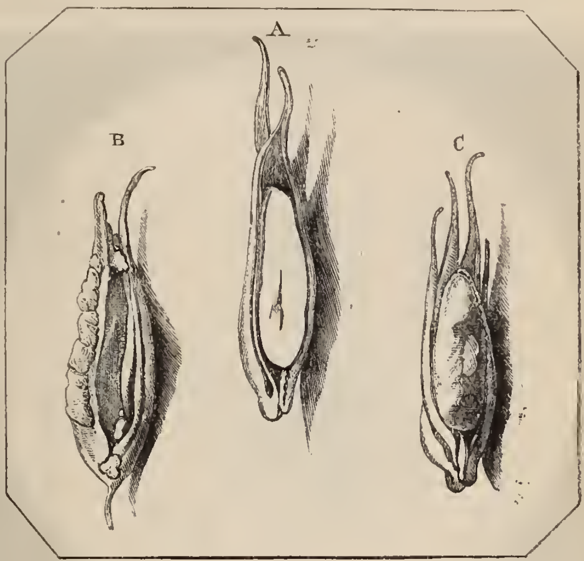
Some of the oats were sent by Mr. Mitchell to Professor Varnell, of the Royal Veterinary College, London, who tried the following experiments:—

On the 10th Sept., 1861, a brown mare was procured by the college for the purpose of being fed upon the suspected oats. She was old, but apparently in a healthy condition. On the first day she had only one feed of the oats given her; on the 11th she had four feeds, and the same quantity on the 12th. On the 13th she had only three feeds, for during the afternoon of this day she was observed to have a staggering gait, and at six in the evening she fell and was unable to get up again. Her hind feet were nearly paralysed. Sensation was so benumbed, that she scarcely responded to the prick of a pin. The visible mucous membranes were pale, the pupils dilated, breathing increased, apparently chiefly from the position in which she laid. The pulse numbered about fifty, and was very feeble; and her tongue protruded from her mouth. She did not appear to suffer much pain. She lingered on until the 15th, when she died.

The oats, which had been examined before by two competent chemists, residing in Leeds, were likewise analysed by Professor Tuson, Lecturer on Chemistry in the Royal Veterinary College, London, who also was unable to detect in them either any mineral or vegetable poison. They were damp, dark in colour, and had a very musty smell. Being more closely examined by Professor Varnell, it was found that many were matted together into lumps by a thready cobweb-like kind of material. The majority of them were covered with a smutty substance, and the interior of a considerable number was decayed, so that instead of the natural white flour of the oats, this was filled with granular matter, which had a blackish-grey hue, and which in many instances projected some distance above the surface of the oat. Under the microscope the thready material was found to consist of elongated cells, and the surface of the oats was covered more or less with well-defined bodies, which were also observed, but in few numbers, to be connected with the thready material; the dark grey matter found in the interior of the oat was granular, the granules being supported by a reticular-like substance.

The investigation was further carried out by Professor Tuson, who has placed his report at my disposal, and I have not only to thank him for it, but also the Editors of the 'Veterinarian' for

Fig. 36.—*Comparative Representations of healthy and mouldy Oats.*



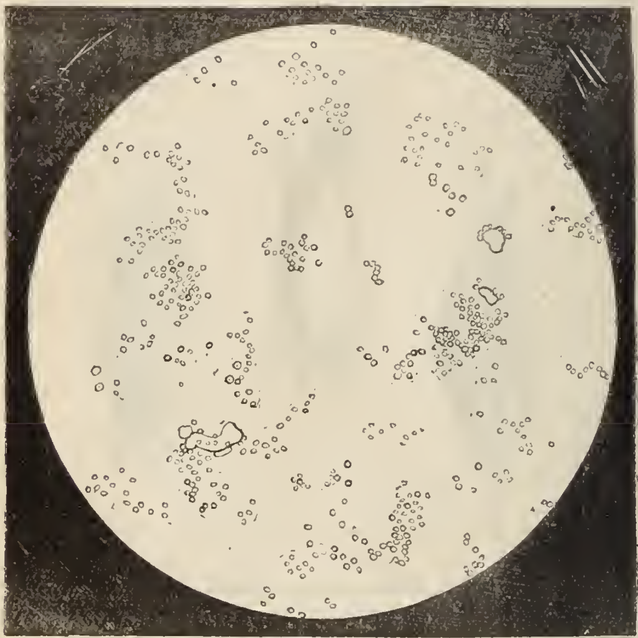
liberally lending me the blocks to reproduce in the Society's Journal the beautiful microscopic objects, a description of which I am permitted to give in Professor Tuson's own words.

General Characters of the Oats.

When examined by the naked eye they were found to be coated more or less completely by a greyish pulverulent matter, which could be easily detached, and by minute specks, having a drab colour, and sometimes a silvery-white appearance.

By referring to B, Fig. 36, one can observe the appearance presented by many of the oats. On the left side of this drawing is represented the greyish deposit in great quantity. It there appears to be convoluted or folded. On making longitudinal sections of some of these oats, the white farinaceous matter contained in oats of good quality was sometimes partially, and sometimes completely, replaced by a dark-coloured, hard, horny mass. C, Fig. 36, represents a vertical section of an oat of this description, in which the horn-like body has been partially developed. A, Fig. 36, is a section of a healthy oat, and is placed by the side of C for the sake of comparison.

Fig. 37.—Appearance of the Pulverulent Deposit on the Skin of the Oats under a quarter-inch object-glass.



Microscopic Examination of the Grey Pulverulent Deposit and of the Horny Mass.

When microscopically examined by a quarter-inch object-glass, the grey pulverulent deposit upon the exterior of the oats, as well as the horny mass contained in them, presented the appearance indicated in Fig. 37.

These small circular bodies are the spores or germs of minute fungi. By instituting a more rigid search, the objects shown in Fig. 38 were discovered. They appear to consist of long tubes terminating in a congeries of minute globular bodies. These are the mycelium or roots of fungi belonging to the Mucor or common mould class.

Microscopic Examination of the surface of an entire Oat.

For this purpose it was found desirable to employ reflected light, and to use an object-glass having a half-inch focal power. A, Fig. 38, represents the surface of an oat upon which is

Fig. 38.—Mycelium of Fungus (Aspergillum) growing on mouldy Oats.

standing, and apparently out of which is growing, a fully-developed fungus of the most beautiful description. The head of this little fungus evidently resembles that of the common mushroom in its general appearance. It belongs to a species of Aspergillum. In the other parts of the same drawing we may easily detect some of the spores depicted in Fig. 37, the mycelium, or roots, shown in Fig. 38, and a number of the mushroom-like fungi (aspergilli) referred to in the preceding paragraph.

Professor Tuson sums up the results of his examination as follows:—

1st. No mineral poison was discovered in the oats by chemical analysis.

2nd. The oats were extensively contaminated by a mould-like fungus.

3rd. It is known, on good authority, that many mould-like fungi are poisonous to animals.

4th. The infected oats were given by Professor Varnell and others to several horses, and the animals subsequently died.

He infers from the facts referred to in his report, that in all probability the infected oats were the cause of the death of the horses.

On showing the drawings of the fungi to Mr. Jabez Hogg, whose intimate acquaintance with microscopic fungi is well known, that gentleman at once identified the fungi, portrayed in Fig. 38, as a variety of *Aspergillum.*

Mr. Hogg further stated he had no hesitation in saying that the horses were killed by the fungus attacking the oats; for he knew of many instances in which sickness and death had been occasioned in various animals by the very same species.

In support of his conclusions, Professor Tuson quotes a passage from the Rev. M. J. Berkeley's 'Outlines of British Fungology,' in which the author says: "It is observable that the same bad effects are sometimes produced by mouldy (fungus-containing) provisions which are produced by ergot in bread." And also extracts from a lecture by the Rev. Edwin Sidney, at the Annual Meeting of the Royal Agricultural Society, held at Norwich, July 18th, 1849. The lecturer describes a fungus called *Ustilago hypodytes* as "a species of penicillium which attacks grasses or hay, and appears to be quite poisonous. The structure, in a very young stage, is thread-like; but all traces of mycelium (spawn) soon disappear, and nothing remains but a mass of minute spores. In addition to the ruin of the grass, this fungus is most pernicious. According to Leveillé, the immense quantity of black dust resulting from it in the hay-fields of France, produces disastrous consequences on the haymakers, such as violent pains and swellings in the head and face, with great irritation over the entire system."

Mr. Sidney further states that penicillium, the mould on hay, "is found on bread, also in the inside of casks; and that there is reason to believe its spores to be poisonous, for two coopers who entered a great tun, covered with this mould, to clean it, inhaled them, and were seized with violent pains in the head, giddiness, and vomiting, which only yielded to severe medical treatment."

The preceding observations of Professor Tuson are highly interesting, for they throw much light on the injury which mouldy or stale oilcakes have frequently been observed to produce. Adulterated or mixed linseed-cakes, in particular, are apt to cause injury to animals, and if we remember for a moment what materials are often employed by the makers of cheap adulterated linseed-cakes, or compound feeding-cakes, we can only feel surprised that complaints respecting injury done to stock fed upon them are not more numerous. Still, complaints of that kind are constantly brought under my notice, and I am convinced that many apparently unaccountable losses which stock-farmers experience are traceable to the bad condition of the cakes on which the animals have been fed.

Reference has already been made to the death of several animals fed upon cake, which, on examination, was found composed mainly of the siftings or screenings from linseed. As a further illustration of the danger of feeding animals on mixed refuse feeding materials, I may quote the case of a gentleman who lost fourteen sheep, three horses, and a pony by feeding them on food which he bought as cattle-food.

On receipt of a sample of the food which had done all this mischief I submitted it to a careful examination, naturally suspecting some mineral or vegetable poisonous material to have become accidentally mixed up with otherwise good feeding substances. However, I failed to detect in it any mineral poison, nor could I recognise in it any organic substance which is known to possess poisonous properties. I found it to be a mixture, in which the following ingredients were readily distinguished:—

Irish moss, cotton seeds, and bits of cotton seed-cake; fragments of locust-beans, earth-nut-cake, and broken earth-nuts; bits of linseed-cake, linseed, vetches, Indian corn, beans, lentils, Dari-grains, barley, hemp-seed, wheat, oats, niger-seed, peas, rape-seed, white and black mustard, rye, clover, grass-seeds, bran, and a good deal of dirty-looking meal or dust.

A good many of the bits of cake in this heterogeneous mixed food were covered with mould, as were also many of the grains of broken wheat, oats, and barley; and I have no doubt that the dust was full of the spores (germs) of fungi, which in all probability caused the death of the animals.

This cattle-food consisted chiefly of the accumulations of broken cake, and the sweepings of a general grain or seed warehouse, and was readily recognised as such.

Similar mixtures of all kinds of feeding matters are freely used by makers of adulterated linseed-cakes, or compound feeding-cakes, and are a fertile source of the injury which such cakes are liable to produce when given to sheep or cattle in any considerable quantity.

It is difficult at all times, and in most cases next to impossible, to ascertain positively whether in the manufacture of cheap compound-cakes or inferior adulterated linseed-cakes, materials have been used which in a separate form were unsaleable, because their condition was such as to render them unfit for feeding purposes. It is easy enough to recognise an oilcake covered with mould, and possessing a rancid and sour taste and fusty smell, as a material which cannot be given with impunity to cattle; but when the same cake has been superficially scrubbed with a hard brush, stove-dried, ground fine, and mixed with some good linseed and pressed afresh into cake, the bad and injurious properties of the spoiled food, which forms a part of the compound cake, may become disguised by the process of manufacture to an extent which renders it impossible to determine by any known chemical test whether the compound or adulterated linseed-cake will be wholesome, or prejudicial to the health of the animals that are fed upon it. An analogous example of the difficulty of recognising by analysis, or by the most careful inspection or microscopic examination, the poisonous characters of a compound article of food, is presented to us in sausages, made partly from diseased and unwholesome meat. In a separate form such meat presents to the eye and touch such an unmistakeably bad condition, that the meat-market inspector feels no hesitation in condemning it at once as unfit for human food; but if it should happen, as it does sometimes, that diseased and unwholesome meat finds its way into the hands of the unscrupulous pork-butcher and sausage-maker, and is by him boiled, minced fine, mixed with bread-crumbs and some good minced pork, salt, spices, &c., and made into sausages, nobody can say *à priori*, nor ascertain by chemical analysis, whether the sausages are likely to prove wholesome or poisonous to those who partake of them; and it is only by the effects which such food produces on the system that its true character becomes apparent. Nor is it always possible, by the effects which suspected articles of food produce, to discern distinctly their dangerous or injurious properties, for the constitution of individual animals varies greatly, and with it their power to resist the evil effects which damaged and mouldy feeding materials produce on less vigorous constitutions. Hence the same food, which apparently does no harm to some animals, seriously affects the health of others, and may become rank poison to individual heads of the same herd.

There is one species of cake which is rarely seen by farmers, for it is seldom offered for sale in the open market; nevertheless it is consumed in large quantities in the shape of linseed-cake. I allude to earth-nut-cake. Frequently earth-nut-cake is so rancid, stale, or mouldy, that it is only fit for manuring purposes; and yet we never hear of earth-nut-cake having been offered for sale as a manuring cake. But its frequent occurrence in linseed-cake, reported to have done mischief to stock, renders it more than probable that at any rate the bulk of the damaged earth-nut-cake finds its way into the mills of oilcake crushers who sell mixed or adulterated linseed-cakes.

Dozens of oilcakes have been sent to me for examination, on account of the prejudicial effects which they were alleged to have produced on sheep and cattle fed upon them, and in no instance have I been able to detect any positively poisonous substance in them, though I have often found earth-nut-cake. Although I am not prepared to say positively that these adulterated oil-cakes were unfit for feeding purposes, the frequency of the occurrence of earth-nut-cake in suspected oilcakes, coupled with the well-authenticated fact that rancid or damaged earth-nut-cake is largely used for adulterating linseed-cakes, and is prejudicial to stock, inclines me to believe that the cause of the injurious properties of adulterated linseed-cakes is referable in many instances to the rancid and bad condition of the earth-nut-cake used in their manufacture.

In conclusion, I hope that all sections of the agricultural community will resist, by all means in their power, the use of a trade-custom which regards the designation "linseed-cake" as a generic term to be applied to all manner of feeding cakes, provided they contain some linseed, no matter however little it may be, and which indicates the distinction between the different qualities by the graduated trade-marks of various makers.

Laboratory, 11, *Salisbury Square, Fleet Street, E.C.,*
August, 1872.

II.—*Report of the Judges on the Trials of Portable Steam-Engines at Cardiff.* By F. J. Bramwell, C.E., and W. Menelaus, C.E. *With an Appendix on the Composition and Calorific Power of Llangennech Coal.*

The Judges, in their Report on this class of engines, and on the fixed engines, tried at the Bury Show in 1867; in their Report on the semi-portable, and on the fixed engines tried at

Oxford in 1870; and lastly, in their Report on the traction engines tried at Wolverhampton in 1871, have had to comment on the attempt, or on the absence of an attempt, by the Society, to settle that most difficult question, What shall be deemed a "horse-power"—not the theoretical horse-power, but the commercial horse-power. The theoretical horse-power, as all engineers and all readers of the 'Journal' of the Society know, is 33,000 lbs. raised 1 foot high in a minute, or the equivalent of this, *i. e.* such a number of pounds as will give, when multiplied by the feet moved through, the sum of 33,000 as the result. It is not the settlement of this horse-power, then, which has occupied the Society from time to time, but the settlement of how many such theoretical horse-powers an engine shall be capable of developing for one commercial or nominal horse-power; in other words, the difficulty is to determine, what size of engine shall be given to a purchaser for a nominal horse-power. Upon this question of size will depend, whether, when an engine, say a 10-horse, is put to work, it will give to its users 20, 30, 40, or even 50 theoretical horse-power for the commercial or nominal 10-horse-power. With respect to horse-power, the purchasing public behave towards engine-makers in, we were about to say, a very Jack Cade sort of spirit; but we feel that this would be unjust towards Jack Cade. That enlightened representative of the people merely required that "seven halfpenny loaves should be sold for a penny, and that the three-hooped pot should have ten hoops" (or about $3\frac{1}{3}$ to 1), while the purchasing public will not be content unless the 8-horse engine will work up to 30-horse, and they like as much more as they can get.

At Bury, the Society determined that engines with single cylinders should have a piston area of 10 circular inches for each horse-power, so that a 9-inch cylinder, giving 81 circular inches of area, was taken as $8\frac{1}{10}$-horse-power. But if the engines had two cylinders, as many had in those days, then, for some never explained reason, in fact for an inscrutable reason (if that which is inscrutable can be a reason), their aggregate area, in circular inches, was to be divided by 9, as with two cylinders that number of circular inches was to be deemed to be sufficient for a horse-power.

At Oxford, the Society left the Exhibitor to give any measure he pleased, so long as he did not exceed 13·14 circular inches in piston area, per horse-power, for the 4-horse engines; and 13·22 circular inches per horse-power, for the 10-horse engines.

It will be seen that these Oxford rules were about from 30 to nearly 50 per cent. in excess of the Bury rule; according as the 10, or the 9, circular inches there prescribed, be used as the standard of comparison.

At Wolverhampton, the Society gave up the task altogether, and left each Exhibitor to do that which was right in his own eyes; the result was, that the circular inches varied from $10\frac{1}{8}$ to $8\frac{1}{10}$ per horse-power.

This year, however, the Society thought it right once more to lay down a rule. It was as follows, Condition II.:—

> "The nominal power of the engines entered for trial will be taken at $\frac{1}{3}$ the indicated power, at 60 lbs. pressure in the boiler, cutting off at $\frac{3}{4}$ the stroke, and the periphery of the fly-wheel running 1884 feet per minute."

This rule is clearly based on the speed of strap usual for driving threshing-machines, and it will be seen was intended to limit the purchaser's views to just about, or a little below, the true Jack Cade standard, viz., to a demand of about three times the nominal power, and it is said to have had the result of satisfying everybody interested. This being so, it would be improper for the Judges to make any comment upon it. They will therefore only say that they do not understand how a rule, which, while specifying fly-wheel rim speed, ignores the length of stroke and the diameter of fly-wheel, can by any possibility be practically applied, unless there be an uniformity of proportion among the makes of portable agricultural engines as regards these two points. In effect, this seems to be nearly so, and thus, the speed of the fly-wheel rim is an exponent of the speed of the piston. Were it not, this curious event would happen, that if a maker sent two engines to be tried, exactly alike in all respects except in the diameters of the fly-wheels, the engine which had the smaller fly-wheel would be estimated as being of proportionately greater power than the engine which had the larger wheel: so that a maker, by halving the diameter of his fly-wheel, could double the nominal power of his engine, because to attain the same rim-speed, he must make double the number of revolutions that he would have to make if he used the larger wheel, and thus the calculated indicated power would be doubled. It is true that the boiler would not, in all probability, supply the steam for the double speed, but then, Condition II. does not say that it shall, but merely provides a basis of calculation for the power of the engine, on the assumption that the steam is there.

It is much more easy, however, to criticize than to suggest a remedy. One of the writers of this Report has the honour to be a Member of Council of two engineering societies, to which the Board of Trade, some months since, addressed letters, asking their advice as to what could be done to define a commercial horse-power. One of these societies is the Institution of Naval Architects, and, as their action in the matter is over, the writer is at liberty to state what took place.

The letter of the Board of Trade was as follows :—

Board of Trade, Whitehall Gardens, 22nd March, 1872.

Sir,—I am directed by the Board of Trade to enclose some copies of a Memorandum on "Horse-power" of steam-engines.

Representations have been made to the Board, that the term "Nominal Horse-power" conveys no definite meaning. This term occurs in Section 5 of the 'Merchant Shipping Act, 1862,' of which a copy is enclosed.

The Board of Trade will be glad to receive any observations on the subject, with which the Council of Naval Architects may be able to favour them.

If some understanding can be come to on the point, a definition of the term might be agreed to, which will be accepted, not only by the manufacturers and users of engines, but by the Legislature, in the event of the term "Nominal Horse-power" being retained when the Statute is revised.

I am, Sir, your obedient servant,

(Signed) Thomas Gray.

The Secretary, Institution of Naval Architects, Adelphi.

The Council of the Institution appointed a Committee to consider the question, and, finally, after two months spent in fruitless discussion, the Council met to consider the Report of that Committee.

The result was the following letter to the Board of Trade :—

Institution of Naval Architects,
9, Adelphi Terrace, London, W.C., 4th June, 1872.

Sir,—In reply to your letter (M) of the 22nd March, in which you ask for certain advice with respect to the term Nominal Horse-power, I am directed to inform you that the subject has been carefully considered by a Committee of the Council of this Institution, with the following results:—

The Committee were unanimously of opinion that the term Nominal Horse-power, as at present ordinarily used for commercial purposes, conveys no definite meaning.

They were also unanimous in considering that the proposal contained in Mr. MacFarlane Gray's pamphlet could not be recommended for adoption. The majority of the Committee were of opinion that no formulæ depending upon the dimensions of any parts of the engines, boilers, or furnaces could be relied upon as giving a satisfactory measure of the power of an engine, and that even if the varieties of engines and boilers now in use could be comprised under one general expression for the power, the progress of invention would soon vitiate any such expression, or formula.

The entire abandonment of an old commercial standard, such as Nominal Horse-power, however inaccurate, must be a matter of considerable inconvenience, and accordingly, great attention was given by the Committee to the question whether that standard could not be amended and retained. Among the many plans considered, not one received unanimous, or even general, approval. That which met with least objection was that the Indicated Horse-power, as ascertained on a trial trip, should be taken either as the Nominal Horse-power, or as a basis for it, being divided by a suitable divisor.

The Committee were of opinion that, for the purposes of the Act, if any standard at all of horse-power is to be used with reference to the Engineers, it would be better to name 400 Indicated Horse-power in place of 100 Nominal Horse-power.

The Committee were also of opinion that all engineers of coasting and sea-going ships should be required to pass some examination, and the Council think it desirable that this opinion should be communicated to the Board of Trade.

I have the honour to be, Sir,
Your obedient Servant,
(Signed) C. W. MERRIFIELD,
Hon. Sec.

The Secretary, The Board of Trade,
Whitehall Gardens, S.W.

The other Society has not, up to the present time, come to a conclusion upon the matter.

The before quoted letter of the Naval Architects to the Board of Trade is abundant proof, if proof were wanted, that the settling of what shall be considered a Commercial horse-power, is among the most difficult problems that can be brought before a practical body; at least it appears so to those who have tried to solve it, but to those who have not, it seems extremely simple.

A barrister lately said to the same writer of this Report, "You surely do not mean to tell me that you do not know what a horse-power is, you, that have been a mechanical engineer all your life!" The answer given was—"Indeed, I do not, there is a difficulty in the outset; what sort of horse-power do you mean?"

"Why, I mean a horse-power."

"I know you do, but there are five kinds of horse-power."

"Five kinds! impossible, it can't be."

"But there are: I will give you the names and the nature of them."

"1st. The real horse-power, the power of a horse, estimated to lift 22,000 lbs. 1 foot high per minute.

"2nd. That which in James Watt's time was called the Nominal horse-power, a horse-power of 33,000 lbs. raised 1 foot high per minute, which power he gave to all his early engines, so that the purchaser, having one-and-a-half times the power of a good horse, should not be in a position to complain of the engine as inadequate.

"This term *Nominal* is now commonly confounded with the *Commercial* horse-power, and the name, Theoretical horse-power, is substituted to represent the received scientific horse-power of 33,000 foot-pounds.

"3rd. The Gross Indicated horse-power. This is the whole power developed on the piston of the engine, without any deduction for friction, which power divided by 33,000 gives the Gross Indicated horse-power.

"4th. The Net Indicated horse-power. This is the same as the foregoing, minus a certain allowance for friction.

"5th. The Commercial, or as it is now frequently called, the Nominal horse-power. This is the horse-power, about which no two persons can agree."

Such are the obstacles that beset men acquainted with the subject, when they endeavour to settle the question, while, as before mentioned, those who have not that acquaintance, see not the slightest difficulty in dealing with the matter.

As an example of this, an enthusiastic bystander rushed up to one of the stewards at Cardiff, to point out the gross unfairness of the trials, because an exhibitor was working an 8-horse engine at a greater power than 8-horse on the brake. This gentleman was not a manufacturing engineer, and we need hardly say he was not a purchaser of steam-engines. The purchaser, no doubt, would wish to be delivered from such a solver of the Commercial horse-power difficulty.

The Judges are sorry to have consumed so much time in considering this question of Commercial horse-power, but they have done so, in order that their readers may be in possession of the history of the Society's efforts on the subject; and that they may see how great are the difficulties in the way of a solution of that which, at first sight, appears so simple a question.

No restriction as to the horse-power at which the engines were to be worked on the dynamometrical brake were imposed; the Exhibitor was left at perfect liberty, so long as he did not exceed the declared pressure of steam. Condition VI., which regulated these questions, was as follows:—

"Exhibitors shall, on making their final specifications, elect at what steam-pressure not exceeding the declared pressure, what horse-power on the brake, and what number of revolutions they would wish to be tried."

Conditions as to the engines being each worked by one man, as to taking the indicator diagrams, as to ascertaining the evaporation of water, and as to the amount of oil and tallow used, were laid down similar to those which were stipulated for at Wolverhampton.

On this occasion, at Cardiff, the whole of the Exhibitors who entered "engines," entered them as 8-horse power; one maker, however, did not venture, in the Catalogue, to state the horse-power, but gave simply the diameter of his cylinder. All the engines were single-cylinder engines; the two-cylinder type, of which, as before stated, several were exhibited in 1867 at Bury, being now entirely abandoned in engines of the 8-horse size.

Two additional, and most salutary conditions were imposed on the Exhibitors; they are given in the latter part of Condition V., and are as follows:—

"Over and under-running will not be permitted; steady running as nearly as possible at the speed declared at entry will be considered a point of merit. The engines must be fitted with governors, and the efficiency of the latter will be tested, after the trials for economy of working are over, by suddenly varying the load on the brake."

Following up the suggestion contained in last year's Report, the Judges endeavoured to get the heat of the escaping gases in the smoke-boxes. Unhappily the arrangements were not sufficiently near to perfection, to enable observations that could be relied on to be obtained in all cases; those which are worthy to be recorded are given in the Table II. It is much to be regretted that the whole set are not complete; but enough was done to show that, except in one or two instances, the heat was very effectually abstracted from the products of combustion, and that they carried very little waste with them up the chimney. There was a most marked improvement on this point, as compared with the condition of things at Wolverhampton; where in every case that was tried, rough though the trial was, the temperature was high, while in some instances it was so great as to melt lead freely. The result of the Exhibitors' attention to this matter has been most gratifying; for, whereas at the Wolverhampton meeting the average evaporation from cold water was only 6·9 lbs. of water per lb. of coal consumed, equal to 8 lbs. of water evaporated from 212°, the quantity boiled off at Cardiff averaged 9·85 lbs. from 212°; and while this is the comparison of the *average*, the comparison between the *best* performance at Cardiff, and the *best* at Wolverhampton, is equally satisfactory. At Cardiff, as much as 11·83 lbs. from 212° was evaporated as a maximum, while at Wolverhampton only 7·76 lbs. were boiled off from cold water, equal to 9 lbs. from 212° as a maximum.

The Prizes offered were as follows:—

For the best Portable Steam-Engine (not self-moving), not exceeding 8-horse-power		40*l*.
For the second ditto	ditto	20*l*.

The following is the list of engines that were originally entered for trial. This list shows also the order in which they were to be tried, that order being determined, as usual, by lot.

5024 Marshall, Sons, and Co., Limited.
*4975 Wallis and Steevens.
4942 Clayton and Shuttleworth.
4834 Hayes, Edward.
4959 Davey, Paxman, and Co.
*4896 Tuxford and Sons.
*5043 Lewin, Stephen.

*4227 Holmes and Sons.
*4912 Willsher, J. C.
4894 Brown and May.
4991 Tasker, W., and Sons.
2927 Reading Iron Works Company, Limited.
†4245 Turner, E. R. and F.
5037 Hindley, E. S.
2950 Barrows and Stewart.
4004 Ashby, Jeffery, and Luke.

Of these engines those marked with an asterisk did not run; the causes which prevented them from so doing are stated below. The one marked,† though it ran, could not compete for the prizes; the reason will appear in the description of the trial of this engine.

4975. *Wallis and Steevens.*—This engine had not arrived at the time of the commencement of trial, and it was therefore thrown out from the competition.

4896. *Tuxford and Sons.*—Unhappily the boss of the fly-wheel of this engine cracked, and occasioned the trial to be stopped.

The exhibitor was directed to repair the boss, and was informed that he would then be allowed to go on with the trial. Instead of repairing the boss he inadvertently provided himself with a fly-wheel, belonging to another exhibitor. It was felt that if it were once allowed to an exhibitor to have a machine tried, some portion of which was not made for the machine—was not even purchased for it, but was merely on loan—it might cause much irregularity hereafter. On these grounds it was impossible to allow the trial to proceed.

5043. *Stephen Lewin.*—This engine, while on the "brake," suffered so much from a hot bearing, that the trial was (with the fullest consent of the exhibitor) stopped; and the engine was withdrawn from competition.

4227. *Holmes and Sons.*—This engine did not come to trial.

4912. *J. C. Willsher.*—Unhappily the fly-wheel boss of this engine was broken on the journey, and at the same time the shaft was bent, and thus a trial became impossible.

As the engines were to be tried to ascertain to what extent they were under the control of their governors, it became necessary not to throw the governor out of work; this throwing out of work was the course pursued on former occasions, with the object of ensuring that the throttle-valves should be wide open at the end of the preliminary run, and also at the end of the final run; but the throttle-valve being now left in gear, some other means had to be devised to prevent advantage being taken of any difference between the area of the opening for the steam at the end of the final run, and the area of that opening at the end of the preliminary run.

A "notice" was therefore issued that, on the preliminary run, the pressure of steam at which the engine first fell below the declared speed would be recorded; and that in the final run the trial would be stopped as soon as the pressure fell to the same point, or as soon as the speed got below the working revolution, whichever event might first happen.

The engines had delivered to them the usual 14 lbs. of coal per brake horse-power; this coal was from the Llangennech Colliery, the coal with which the Society's trials have been made for years past.

The following is a description (in the order in which they ran) of the various engines that were tried upon the brake.

It is to be feared there will be found in this description a great deal of repetition, as in several of the points many of the engines were so nearly alike that the same language might properly be applied to them; but to prevent confusion, and to obviate the necessity of referring from the description of one engine to that of another, it has been thought better to describe each engine as though it stood alone.

The first engine on the list for trial was that of Messrs. Marshall, Sons, and Co. (Limited), of Gainsborough (No. 5024). Price 230*l.*

This engine has a cylinder of 8½ inches diameter, 1 foot length of stroke. The heating surface is 283·5 feet, the fire-grate is 4·4 feet; but at the time of the trial fire-bricks were introduced, so as to reduce the effective area of the fire-grate surface to 3 feet.

These exhibitors elected to work at 14 horse-power on the brake; and at 165 revolutions per minute; they also elected to work at the maximum pressure allowed, viz., 80 lbs.

The construction of this engine is as follows:

The cylinder is placed upon the fire-box, and takes its steam from an internal pipe, the end of which, nearest to the smoke-box, is made with a number of slots on the upper side to receive the steam. The cylinder is steam-jacketed, as also are both covers. The slide-jacket is cast with the cylinder, and on it and on the cylinder are two lugs, to which are bolted the solid ends of two tubular wrought stays, which extend from the cylinder to the crank-shaft bearings. These bearings are made of gun-metal, carried on cast-iron blocks; to bosses in which the tubular stays are attached. The bottoms of the cast-iron blocks are furnished with dovetails, free to move in dovetailed grooves, formed in the upper part of other castings, bolted to wrought brackets riveted to the boiler. By this arrangement, the exhibitors suggest, that there is freedom for the expansion of the boiler, and that the strain is taken by the stay-bolts which connect the cylinder casting to the crank-shaft bearings. In these stays is also carried a wrought-iron frame, to receive the outer ends of the guide-bars, and to support the governor-bracket.

The frame has a bottom piece which bears upon a boss on the top of the boiler cleading, or rather on the top of the feed-heater, to be hereafter mentioned, but this bottom piece has no connection with the boiler. The crank-shaft is a "bent-shaft," and is made of Stenson's mild steel. On the one end is the fly-wheel, provided with counterbalance, and on the other the eccentric, driving the feed-pump.

The four guide-bars are of cast steel. The guide-blocks are of cast iron, and an adjustment for wear is made by brass liners to the guide-bars.

The steam is admitted to the cylinder by two gun-metal short slides, connected by a rod with an adjusting screw. These slides have, cast through them, passages to admit the steam from expansion-valves, working on the back of the principal slides; these passages are vertical in the working face of the main slides, but are at an angle of 52° to the horizontal in the back faces of those slides, the passages being twisted in their progress through the body of the slide. The pair of expansion slides are of gun-metal, and have bevelled ends, at the same angle (52°) as the openings in the main slides. The expansion-slides are driven by a slide-stalk, having on it a pair of eccentrics, working in blocks carried in brackets attached to the backs of the expansion-slides, in which brackets the blocks are free to slide. The slides are driven by the sides of the eccentrics; and by their circumference, on the partial revolution of the slide-stalk, the expansion-slides can be raised or lowered. As the ends of these slides are bevelled, the raising or lowering has the effect of lengthening or shortening the expansion-slide in relation to the angled passage in the main-slide, and thus of varying the expansion. The expansion-slides have bridges over their backs, and are adjusted to fit these bridges in order to remove a portion of the pressure of the steam. The bridges are separate from the slide-jacket, and are fitted against stops, up to which they are pressed by springs at their backs, so that in the event of there being any water in the cylinder, both slides and bridges yield, and allow of its escape.

Fig. 1.—*Indicator-Diagram of Messrs. Marshall, Sons, and Co.'s Portable Engine, No.* 5024 (No. 2 diagram, 14 lbs. spring).

There are two eccentrics, one for the principal slide, and one for the expansion-slide, in the usual manner. That for the principal slide is driven by a plate having two holes in it, the one for head, the other for stern gear. The expansion-slide is set midway, so as to suit either head or stern gear. Immediately beyond the guide in which the expansion slide-stalk works, there is a socket in which the stalk can turn, and on the slide-stalk there is an arm worked by the governor, so that as the governor rises or falls, it causes the expansion slide-stalk to make a portion of a revolution, and thus to raise or lower the back slides, to vary the amount of expansion, and to regulate the speed of the engine. There is no throttle-valve, nor any apparatus whatever, other than these slides, for the purpose of regulation.

The centre line of the engine is not parallel with that of the boiler, the crank shaft end being somewhat the higher.

TABLE I.—SIZES AND CONSTRUCTION OF THE PORTABLE STEAM ENGINES TRIED AT CARDIFF.

LEADING PARTICULARS OF CONSTRUCTION.

BOILER. — Elements of Safety; Fire-grate; Flue Area.

1. Catalogue Number.	2. Name of Exhibitor.	3. Nominal Power. (maker)	4. Price.	5. Weight Empty in Cwts.	6. Carriage.	7. Elements of Safety: Maximum declared Pressure.	8. Elements of Safety: Safety Valves.	9. Elements of Safety: Pressure Gauge, High or Low.	10. Elements of Safety: Height of Bottom of Gauge-glass above Fire-box Crown.	11. Fire-grate: Size of ordinary Grate in Inches.	12. Fire-grate: Area of ordinary Grate in Square Feet.	13. Fire-grate: Width of Bars and Air Spaces.
		HP	£.						Inches.			
5021	Marshall Sons, & Co.	8	230	80	Wrought-iron, with wrought-iron wheels.	120 allow for 80	2 2-in. spring valves	Register. 2 lbs. high.	Level	27 × 23	4·4	⅝-in. bars, 1/16-in. spaces.
1912	Clayton & Shuttleworth	8	210	80	Wood frame and wrought-iron wheels.	80	1 2-in. lever and spring valve. 1 2½-in. lock-up valve.	5 lbs. high.	3	26¾ × 29	5·3	⅝-in. bars, ·23-in. spaces.
1834	E. Hayes	8	230	65	Wood frame and wheels.	70	2½-in. spring valve. 2-in. ditto.	1 lb. high.	1¼ above.	23 × 32	5·1	1-in. bars, ·35-in. spaces.
4959	Davey, Paxman, & Co.	8	230	77	Cast and wrought-iron wheels, wood carriage.	80	2½-in. spring. 2-in. lock-up.	1 lb. high.	1¼	18 × 30	3·75	⅝-in. bars, ·22-in. spaces.
1896	Tuxford & Sons ..	8	240	70	.. ..	80	2 2½-in. spring valves	½ lb. low.	1½	26 × 31	6·13	⅝-in. bars, ·22-in. spaces.
1891	Brown & May	8	230	65	Wrought-iron wheels, wood carriage.	80	1 2-in. spring. 1 2-in. lock-up.	2 lbs. high.	5/16	18 × 25½	3·2	⅝-in. bars, ½-in. spaces.
4991	Tasker & Sons	8	210	68	Wood wheels and wood carriage.	60	1 2-in. spring. 1 1⅞-in. lock-up.	1 lb. low.	Level	31 × 21½	4·7	½-in. bars, ⅞-in. spaces.
2927	Reading Iron Works	8	235	80	Iron frame and wrought and cast-iron wheels.	80	1 spring, 2 in. diam. 1 lock-up, 1⅞ in.	2 lbs. high.	¾ above.	30 × 34½	7·2	½-in. bars, 5/16-in. spaces.
5013	Stephen Lewin ..	8	230	80	Wood travelling-wheels.	80	1 2½-in. spring. 1 2-in. lock-up.	Correct.	1¼	20½ × 30	4·3	½-in. bars, ¼-in. spaces.
1245	E. R. & F. Turner ..	8	215	80	Wood wheels, iron carriage.	80	1 spring, 2 in. diam. 1 lock-up, 1⅞ in. diam.	2 lbs. high.	1¼	20 × 25¼	3·5	½-in. bars, ¼-in. spaces.
2950	Barrows & Stewart ..	8	230	72	Wood fore-carriage and wood wheels.	70	2 2½-in. spring safety-valves.	7 lbs. high.	¾	29½ × 24½	5·0	⅝-in. bars, ·28-in. spaces.
4901	Ashby, Jeffery, & Luke	8	230	80	Wood carriage and wheels.	80	2-in. spring; 2-in. lock-up.	3 lbs. high.	3/16	25 × 31½	5·5	½-in. bars, ¼-in. spaces.
	Averages	..	..	..	.. ..	..	.. ..	..	..	..	..	..

BOILER (continued). — Fire-grate; Flue Area; Heating Surface.

1. Catalogue Number.	2. Name of Exhibitor.	14. Area of Air Spaces between Bars in Square Feet.	15. Area of Grate used on Trial.	16. Area of Air Spaces in Trial.	17. Height of Fire-box Crown above Bars.	18. Flue Area: Area through Tubes.	19. Flue Area: Ratio of Area in Fire-grate, ordinary.	20. Flue Area: Diameter of Blast Orifice in Inches.	21. Heating Surface: Length between Tube-plates, and Number and Outside Diameter of Tubes.	22. Heating Surface: Surface in Fire-box.	23. Heating Surface: Surface in Tubes and Smoke-box.	24. Heating Surface: Gross Water-heating Surface.	25. Heating Surface: Super-heating Surface.	26. Ratio of Heating Surface to ordinary Fire-grate Surface.	27. Square Feet of Heating Surface per Nominal HP. of Engine.
				Sq. feet.	Inches.	Sq. feet.				Inches.	Sq. feet.				
5021	Marshall Sons, & Co.	1·5	21½ in. × 20 in. = 3 sq. ft.	1·14	33½	0·83	·19	3 to 1½	90 in. 80 tubes, 1⅞-in. dia.	26·3	257·2	283·5	The upper parts of smoke-box tube-plates only—averaging 1¼ to 2 square feet.	61·	35·4
1912	Clayton & Shuttleworth	1·8	19 in. × 24 in. = 3·2 sq. ft.	1·13	30½	1·22	·23	2¼	72 in. 56 tubes, 2 3/16-in. dia.	25·4	194·6	220·0		61·	27·5
1834	E. Hayes	1·13	All ordinary grate, 5·1 sq. ft.	1·13	32½	0·8	·157	1½	36 tubes, 78⅞ × 2¼ in.	28·6	142·0	170·6		33·	21·3
4959	Davey, Paxman, & Co.	1·0	3·75 sq. ft.	1·0	30½	0·68	·18	1⅜	39 tubes, 77 × 2 in.	35·4 including Davey & Paxman's tubes.	133·0	168·4		45·	21·0
1896	Tuxford & Sons ..	2·1	24 in. × 12 in. = 2 sq. ft.	0·71	31	1·14	·186	2	41 tubes, 72 × 2½ in.	30·0	163·0	193·0		31·	24·1
1891	Brown & May	0·64	3·2 sq. ft.	0·61	29½	0·73	·23	A ring with adjustment nearly filling chimney.	42 tubes, 75 × 2 in.	19·8	139·3	159·1		50·	19·9
4991	Tasker & Sons	1·47	All ordinary grate, 4·7 sq. ft.	1·47	34	0·93	·2	2	33 tubes, 74 × 2 7/16 in.	27·8	130·2	158·0		34·	19·8
2927	Reading Iron Works	2·5	28½ in. × 12 in. = 2·37 sq. ft.	0·92	38	1·33	·185	2	39 tubes, 72 × 2¼ in. outside.	39·4	171·6	211·0		29·	26·4
5013	Stephen Lewin ..	1·1	11 in. × 21 in. = 1·6 sq. ft.	0·43	31	1·05	·24	1 1/16	38 tubes, 60 × 2½ in.	24·4	127·2	151·6		35·	18·9
1245	E. R. & F. Turner ..	0·86	All ordinary grate, = 3·5 sq. in.	0·86	26½	0·8	·23	2⅝	55 tubes, 74 × 1⅞ in.	18·8	169·0	187·8		54·	23·5
2950	Barrows & Stewart ..	1·1	All ordinary grate, = 5·0 sq. ft.	1·1	31½	0·75	·15	2	22 tubes, 76 × 2¾ in.	27·4	102·4	129·8		26·	16·2
4901	Ashby, Jeffery, & Luke	1·6	16 in. × 18 in. = 2 sq. ft. in 2 compartments.	0·66	30½	0·82	·15	1¾	62 tubes, 73½ × 1¾ in.	27·8	176·7	201·5		37·	25·6
	Averages	..	..	..	..	..	·194	..	..	..	..	..	..	40·	23·3

ENGINE.

1. Catalogue Number.	2. Name of Exhibitor.	28. Diameter and Stroke of Piston.	29. Diameter of Fly-wheel.	30. Cylinder, how Protected.	31. Valve Gear and Eccentrics.	32. Crank, Internal or External.	33. Feed-pump and Feed-heating Apparatus.	34. Remarks.
		Inches.	Inches.					
5021	Marshall Sons, & Co.	8½ × 12	55½	Cylinder and covers steam-jacketed and lagged.	Double eccentrics and expansion-valve worked by governor.	Internal	1 pump and cast-iron feed-heater on boiler top, containing 4 lengths of copper pipe.	Main bearings supported by stays from cylinder, and in dovetailed guides carried by boiler.
1912	Clayton & Shuttleworth	9 × 12	55 and 60½	Cylinder and covers steam-jacketed in smoke-box.	Double eccentrics and expansion-valve worked by governor.	Ditto ..	Feed-heating tubes in an annular casing in smoke-box, through which exhaust passes.	3 main crank shaft-bearings. Cylinder in top of smoke-box, lined with steel bush.
1834	E. Hayes	9 × 12	60	Wood and felt lagging	Simple eccentric	Ditto.		
4959	Davey, Paxman, & Co.	8¾ × 12	60	Cylinder and covers steam-jacketed and lagged.	Single eccentric and sliding cam worked by governor for adjusting expansion-valve.	Ditto ..	1 pump. Exhaust-pipe into feed-tank. Feed-heater an annular ring in top of smoke-box, 18 in. long, 7¼ mean diameter.	
1896	Tuxford & Sons ..	9 × 12	54	Steam-jacketed and lagged.	Double eccentrics and expansion-valve adjustable by hand.	Ditto ..	1 pump. Feed-heater an annular ring in smoke-box.	
1891	Brown & May	7¼ × 12	40 and 58	Cylinder and covers steam-jacketed and lagged.	Double valves, but no adjustment for expansion.	Ditto ..	Cast-iron feed-heater inside boiler, containing 5 copper tubes for feed to pass through.	
4991	Tasker & Sons	9 × 12	60	Cylinder and covers steam-jacketed and lagged.	Double eccentrics and simple expansion-valve.	Ditto ..	Exhaust-pipe 2 in. diameter, 6 ft. 6 in. long, inside a 3-in. pipe, on boiler top; and a casing, with transverse tubes in smoke-box.	
2927	Reading Iron Works	8½ × 14	66	Cylinder and covers steam-jacketed. Cylinder steel-lined.	Straight ports to cylinder. Valves in halves. Expansion-valves adjustable by governor.	Ditto ..	Annular feed-heater in smoke-box, containing tubes for feed. Exhaust surrounds feed.	Welded iron fire-box, and steel-lined cylinder.
5013	Stephen Lewin ..	8½ × 11	60	Steam-jacketed	Double eccentrics and common expansion-valve.	Ditto ..	1 pump; 2 lengths of copper pipe in cast-iron feed-heater, on side of boiler.	
1245	E. R. & F. Turner ..	9 × 12	40	Cylinder and 1 cover jacketed and lagged.	Single valve, with Hartnell's patent governor and expansion-gear.	Ditto ..	The surplus feed heated by exhaust steam and returned to tank, thus heating all feed-water.	Main bearings supported by stays from cylinder and elastic wrought-iron brackets on boiler. Piston slide-valve.
2950	Barrows & Stewart ..	9½ × 13	60	Not jacketed, except by steam passage round middle of cylinder.	Single valve and eccentric	Ditto ..	Feed-pump worked off piston crosshead, and supported by cylinder flanges. No feed-heater.	
4901	Ashby, Jeffery, & Luke	9½ × 14	60	Cylinder and covers steam-jacketed and lagged.	Double eccentrics and expansion-valve; both valves in halves; no adjustment for valve.	Ditto ..	Pump works direct to boiler, or through feed-heater. Feed-heater = 2 copper-pipes inside 2 exhaust pipes beneath boiler.	
	Averages	..	..					

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EASTONS AND ANDERSON, Consulting Engineers, *September 3rd, 1872.*

Table II.—Results of the Trials of Portable Steam Engines at Cardiff.

1. Name of Exhibitor.	2. Exhibitors' Declaration: Steam Pressure.	3. Exhibitors' Declaration: Revolutions per Minute.	4. Exhibitors' Declaration: Horse-Power on Brake.	5. Preliminary Trial in getting up Steam: Wood used in lbs.	6. Preliminary Trial: Coal used in lbs.	7. Preliminary Trial: Time in raising Water to Boiling-point.	8. Preliminary Trial: Time in getting up Steam of 60 lbs. Pressure.	9. Total Coal used in lbs.	10. Total Number of Revolutions of Brake.	11. Time (actual) running.	12. Time (mechanical) at declared Speed in Minutes and Hours.	13. Mean Steam Pressure in Boiler (corrected).	14. Experiments with Indicator: Indicated Initial Pressure.	15. Experiments with Indicator: Indicated back Pressure to compression corner.
										H. M.	M. H.	lbs.		lbs.
Marshall, Sons, & Co. ..	80	165	14	8	35	Started with water at 150°.	59m. from water at 150°.	196	42,041	4 9	254·8=4·217	80	74 to 80	About 1
Clayton & Shuttleworth	80	140	14	8	53¼	About 46m.	1h. 24m.	196	32,042	4 47	291·3=4·855	80	69·0	1
Clayton & Shuttleworth Second trial.	..	..	..	..	..	..	..	196	33,117	4 54	301·1=5·018	80	74·9	2·4
Hayes, E.	70	130	8	8	..	..	..	112	10,869	1 29	83·6=1·39	63	Diagrams at reduced speed. 41·6	·3
Davey, Paxman, & Co. ..	80	115	12	8	60	1h. 9m.	1h. 38m.	168	29,690	4 20	258·2=4·3	80	73·0	1
Tuxford & Sons	80	135	12	8	55½	1h. 35m.	2h. 30m.	168 served, 46 used.	9,219	1 12	68·3=1·14	80	74·0	1½
Brown & May	80	135	9	8	42	0h. 45m.	1h. 11m.	126	34,513	4 8	255·6=4·26	80½	73·0	1
Tasker & Sons	60	120	12	8	52	0h. 30m.	0h. 53m.	168	20,406	2 45	170·0=2·83	59½	52·0	1½
Reading Iron Works ..	80	140	17	8	56¼	1h. 0m.	1h. 42m.	238	40,826	4 55½	291·6=4·86	80¼	72·5	1
Lewin Stephen	80	140	14	8	64¾	1h. 3m.	..	196 served, 176 used.	22,564	3 8	161·2=2·69	80¼	76·0	..
Turner, E., R., & F. ..	80	180	20	8	56	0h. 42m.	1h. 22m.	280	41,583	3 52	231·0=3·855	80	77·2	1
Barrows & Stewart ..	70	120	12	8	49¾	0h. 35m.	0h. 58m.	168	17,416	2 30	145·1=2·42	70	17·2	1
Ashby, Jeffery, & Luke	80	120	8	8	66	..	About 1h. 23m.	112	13,501	1 48	112·5=1·875	80	63·0	1½
Averages	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Trial on Brake for Power and Economy.

1. Name of Exhibitor.	16. Experiments with Indicator: Indicated cut off.	17. Indicated Mean Pressure available for Power.	18. Mean Speed in Revolutions per Minute.	19. Mean Indicated HP. during Trial, assuming declared Speed.	20. Mean Indicated HP. during Trial at (actual) Speed.	21. Ratio of Brake HP. to Indicated HP.	22. Oil and Tallow used in oz.	23. Coal: Used per Hour (actual) in lbs.	24. Coal: Used per Indicated HP. per Hour in lbs.	25. Coal: Used per Brake HP. per Hour in lbs.	26. Coal: Used per square foot of Grate per Hour in lbs.	27. Coal: Square Feet of Heating Surface per lb. of Coal burnt per Hour.	28. Coal: Percentage of Clinker and Ash produced.	29. Draught: Mean Power of Draught in Smoke-box in Inches of Water.	30. Draught: Mean Temperature of Smoke at Tube ends.
Marshall, Sons, & Co. ..	·17	31·25	168·8	17·56	18·0	·797		47·2	2·62	3·30	15·7	6	..	..	..
Clayton & Shuttleworth	·24	31·7	115·1	13·32	..	..	Some weighings imperfectly checked, results therefore not recorded.	41·0	..	2·884	12·8	5·37	6·8	·2	300° to 418°
Clayton & Shuttleworth Second trial.	·22	32·5	112·6	13·65	13·97	..		40·0	..	2·79	12·5	5·50	..	·125	390° to 415°
Hayes, E.	Wiredrawn to about ·6.	35·1 19·6	122·6	9·72	9·1	·823		75·5	8·30	10·0	14·8	2·26	..	..	548°
Davey, Paxman, & Co. ..	·16 Cut off in Steam-chest.	33·9	114·2	13·66	13·6	·878		38·8	2·85	3·25	10·3	4·31	..	..	320° to 380°
Tuxford & Sons	·18 and ·12	23·9	128·0	12·32	..	..		38·3	..	3·36	19·15	5·01	..	..	..
Brown & May	·1 and ·35	29·2	139·1	9·8	10·1	·92		30·5	3·02	3·29	9·53	5·22	5·8	·125	385°
Tasker & Sons	·38	29·72	123·7	13·6	14·0	·88		61·1	4·36	4·94	13·0	2·58	..	..	About 600°
Reading Iron Works ..	·23	37·0	138·2	20·58	20·32	·826		48·3	2·377	2·881	20·4	4·37	..	·19	425° to 435°
Lewin Stephen	·19	26·8	120·0	14·9	..	..		56·2	..	1·67	35·1	2·70	..	..	..
Turner, E., R., & F. ..	Slightly wiredrawn to ·32.	36·24	179·2	24·9	21·8	·803		72·4	2·90	3·63	20·7	2·59	..	..	500°
Barrows & Stewart ..	Wiredrawn to ·6.	25·8	116·1	14·27	13·8	·81		67·2	4·87	5·78	13·6	1·93	..	·19	Over 600°
Ashby, Jeffery, & Luke	·16	20·4	125·0	12·15	12·6	·66		62·2	4·94	7·47	31·1	3·29	..	..	360° at end of run.
Averages	..	..	..	..	..	·825	..	..	4·02	4·48	17·6	3·94	..	..	..

1. Name of Exhibitor.	31. Water: Total Water supplied to Engine during Trial, and its temperature in lbs.	32. Water: Water returned to Feed-Tank from Condensation in Feed-heater and its Temperature.	33. Water: Water evaporated out of Boiler, lowering Water Gauge and its Temperature.	34. Water: Mean Temperature of Feed on entering Boiler.	35. Water: Equivalent of Total Heating and evaporation in Boiler in lbs. of Water at 212° evaporated at same Temperature.*	36. Water: Useful effect of Feed-heater, in equivalent lbs. of Water at 212°, evaporated at same Temperature.	37. Water: Positive Heat taken from Boiler in net Water evaporated out of it in lbs. at 212°, evaporated at 212°.	38. Efficiency: Duty of Boiler: In Equivalent lbs. of Water at 212° Evaporated at same temperature per lb. coal (not including Steam to some Jackets).*	39. Efficiency: Duty of Boiler: In Equivalent lbs. of Water at 62° Evaporated at 212° per lb. Coal.*	40. Corrected Mechanical Time on Brake, allowing for variation in Water Gauge Level.	41. Ratio of Evaporative Duty obtained in Boiler to Evaporative Power of Llangennech Coal (= 15·24).*
		lbs.	lbs.								
Marshall, Sons, & Co. ..	1792 at 64°.	138	..	208°	2005	288	0	10·23	8·86	254·8	·671
Clayton & Shuttleworth	1907 at 65°.	275 at 173°.	61 at 321°.	209°	2319	325	11	11·83	10·21	289·9	·776
Clayton & Shuttleworth Second trial.	1897·5 at 68°.	330 at 173°.	..	208°	2314	330	0	11·81	10·23	301·1	·775
Hayes, E.	300 at 65°.	20 from Exhaust.	160 at 316°.	120°	509	18	29	4·54	3·93	78·8	·3
Davey, Paxman, & Co. ..	1675 at 65°.	69 at 110°.	..	186°	1852	219	0	11·02	9·54	258·2	·723
Tuxford & Sons	..	..	..	..	..	..	..	..	..	..	..
Brown & May	1147·5 at 63°.	174 Estimated.	4 at 324°.	210°	1370	201	0·7	10·89	9·43	255·5	·714
Tasker & Sons	1315 at 64°.	130 Estimated.	15 at 307°.	164°	1568	150	2·5	9·33	8·08	169·8	·612
Reading Iron Works ..	2355 at 62·3°.	All thrown away.	60 at 324°.	210°	2197	360	11	10·49	9·08	290·3	688
Lewin Stephen	1590	..	..	..	..	..	..	..	..	180·0 with 196 lbs. of coal.	..
Turner, E., R., & F. ..	2310 at 65°.	220 at 162°.	120 at 324°.	162°	2780	251	22	9·93	8·60	229·2	·651
Barrows & Stewart ..	1195 at 66°.	..	100 at 316°.	67°	1506	..	18	8·97	7·77	143·4	·588
Ashby, Jeffery, & Luke	920 at 65°.	..	60 at 321°.	? assumed to be 180°.	1146	..	..	9·27	8·03	111·1	·608
Averages	..	..	..	..	..	..	..	9·85	8·53	..	·65

1. Name of Exhibitor.	42. Efficiency: Ratio of useful effect of Feed-heater, to Total Evaporative Duty obtained in Boiler.	43. Efficiency: Square Feet of Heating Surface in Boiler, per Indicated HP. in Engine.	44. Efficiency: Weight of Steam supplied to Engine per Indicated HP. per hour, (excluding Steam to some Steam Jackets).*	45. Efficiency: Weight of Steam supplied to Engine per Brake HP. per Hour, (exclusive of Steam to some Steam Jackets).*	46. Efficiency: Cornish Duty of Engine in Millions of Foot-lbs. of Work on Brake, per cwt. of Coal.	47. Ratio of Heat, Value of Work done on Brake to Theoretical Heat Power of Coal	48. Effect of Governor in Regulating Speed, the Engine being loaded and light alternately.	49. Remarks.
Marshall, Sons, & Co. ..	·144	15·7	25·9	32·5	67·3	·0529	Speed thoroughly controlled, but slightly increased by removal of load.	*Highly Commended.*
Clayton & Shuttleworth	·14	..	..	33·0	76·53	·0601	Very good	Steam passages to indicator very much throttled.
Clayton & Shuttleworth Second trial.	·143	..	..	31·7	79·49	·0621	.. ..	A second trial after tie with the Reading Company's Engine. *First Prize.*
Hayes, E.	·035	18·7	35·5	48·1	20·8	·0163	Governor useless.	
Davey, Paxman, & Co. ..	·118	12·4	29·7	33·8	68·16	·0535	Very good	The governor hunted, thus constantly altering diagram but maintaining very uniform speed. *Highly Commended.*
Tuxford & Sons	..	..	..	..	65·7	·0516	.. ..	Trial stopped by flywheel breaking and engine subsequently disqualified.
Brown & May	·147	15·7	31·8	34·5	67·15	·0530	Very well to about 30 revolutions.	Indicator string gear unsatisfactory. Rigged partly during trial. Valves found to have shifted. *Commended.*
Tasker & Sons	·096	11·3	37·9	43·0	44·83	·0352	Worked fairly 120 to 180 revolutions.	
Reading Iron Works ..	·141	10·4	21·14	29·2	76·64	·0602	Very well	Condensed water from feed-heater thrown away to keep grease out of boiler. A second trial offered but declined. *Second Prize.*
Lewin Stephen	..	..	..	..	17·5	·0373	.. ..	Engine stopped for hot bearing. Unable to maintain declared speed.
Turner, E., R., & F. ..	·091	7·6	27·6	31·4	60·51	·0175	Exceedingly good, 184 to 190 revolutions.	Official trial stopped twice by loose key in flywheel. The trial recorded was non-competitive. *Silver Medal for Hartnell's Governor.*
Barrows & Stewart ..	..	9·4	37·5	41·6	37·80	·0298	Fair.	
Ashby, Jeffery, & Luke	..	16·2	43·0	65·3	29·11	·0231	Hunted, but had fair control.	
Averages	·117	13·0	32·5	38·6	57·09	·0448	.. ..	

In those engines in which the condensation in the steam jackets returned to the boilers, the actual results in columns marked *, must have been larger than those recorded.

EASTONS AND ANDERSON, Consulting Engineers, *5th September*, 1872.

The feed-pump is immediately below the crank-shaft, from which, as already stated, it is worked by its own eccentric. The pump is always drawing water, and the surplus is returned into the feed-tub by means of an escape cock. That which is not returned goes through a 1¼-inch copper pipe, which passes four times along a heater, formed by the exhaust-steam pipe. This pipe is flat in section, so as to lie on the upper surface of the boiler, and in the thickness of the cleading. There are 8 feet of heating surface in this 1¼-in. pipe. The water, on leaving the heater, passes through a check-valve box into the boiler, near the smoke-box end. There is a three-way cock provided, by which the feed-water may be turned direct into the boiler, without passing through the heater. The waste-steam pipe is fitted with a cone and an adjusting handle, so as to regulate the blast orifice.

The bearing-wheels have wrought-iron spokes and rims, and wrought-iron tyres, shrunk outside all. The spokes are cast into the bosses, which are cast on chill pins. The hind axle, which is secured to wrought brackets, immediately in front of the fire box, is of solid wrought iron. The fore axle is also of solid wrought iron, but passes through a hollow wrought-iron bed, provided with a wrought-iron wheel-plate, having stops on which bears a wrought-iron piece riveted to the bottom of the smoke-box. The arrangement is sufficiently substantial not to require a bottom stay to the perch pin, nor locking-chains to regulate the amount of motion.

The boiler and fire-box are cleaded all over, and the ash-pan is closed, and provided with a damper in the usual manner.

This engine did its work on the brake extremely well. It ran for 4h. 9m. real time, and for 4h. 14m. 48s. mechanical time, representiug a consumption of 3·3 lbs. of coal per brake horse-power per hour. The gross indicated horse-power was 17·56, giving a consumption of only 2·62 lbs. of coal for each such horse-power.

The engine was driven with great regularity. The heat of the feed-water was from 205° to 210°. The quantity of water evaporated, was 1930 lbs., representing 2005 lbs. from 212° = 10·23 lbs. of water per lb. of coal, or (to render the comparison with last year's results easy) 1736 lbs. of water from 62°, equal to 8·86 lbs. of cold water per pound of coal.

The amount of oil and tallow used was noted, but as, unhappily, it is quite certain that in some cases errors were made by those to whom this duty was intrusted, it becomes necessary to omit all record of the consumption of these stores.

On the trial for governing it was found that, even with all the load off, and the steam-regulator wide open, the governor had the engine under complete control, but that it allowed the engine to run some revolutions faster than when doing work.

This engine is an extremely substantial and well-made piece of work; strong in all its parts; and was "Highly Commended" by the Judges.

The next engine tried was No. 4942, that of Messrs. Clayton and Shuttleworth. Price 240*l*.

This engine has a cylinder ot 9 inch diameter, 1·0″ length of stroke, a total heating surface of 220 square feet; total grate surface of 5·3 square feet, reduced, by bricks, on the occasion of the trial to an area of 3·2 square feet.

The exhibitors elected to run at the full pressure of 80 lbs., at 14 horse-power, and at only 110 revolutions a minute.

The cylinder is placed in an upward prolongation of the smoke-box, in the same manner as was pursued by this firm on the occasion of their trial at the Bury Show, with the exception that then the covers of the cylinder were to be seen outside the smoke-box, whereas now the smoke-box is made so much longer as to contain the whole length of the cylinder, leaving only false covers visible, back and front. The cylinder, notwithstanding it is in the smoke-box (perhaps it would be well to say, because, among other reasons, it is in the smoke-box), is steam-jacketed both on the sides and ends. The circumferential steam-jacketing is done by the forcible insertion of a turned and bored steel bush, into the bored recessed jacket-casting.

It is believed that this plan was introduced by the Reading Ironworks Company (Limited) in their engines tried at the Oxford Show.

Lugs are formed on the jacket-casting; and from these two solid wrought-iron stay-rods extend to the crank-shaft bearings, which, in the instance of this engine, are situated over the barrel of the boiler, and near to the fire-box. The crank-shaft is carried in three gun-metal bearings, with side-way adjustment in all three, and with vertical adjustment to the bearing near to the fly-wheel. These gun-metal bearings are seated in cast blocks, provided with channels round about them to collect the oil which may escape from the bearings, and the blocks are furnished with bosses to receive the ends of the stay-rods, by which they are united, as already mentioned, to the jacket-casting.

The cast bearings are bolted to the tops of wrought-iron brackets, which are riveted direct to the barrel of the boiler.

The suggestion is that there is sufficient "give" in these wrought brackets to allow for any movement due to the expansion of the boiler, whilst the stay-rods take the true strain arising from the engine.

The crank-shaft is not "bent," but is made out of the solid; it is of steel, and is provided with two disks, fitted one on each arm of the crank, in which disks are cast blocks to balance the crank. The shaft has on it three eccentrics, one to work the main-slide, one the expansion-slide, and the other the feed-pump.

The steam is admitted into the cylinder through a throttle-valve, which, however, during the runs was not in use, the engine being governed by the expansion-slide.

In the jacket there is the main-slide, composed of two separate short-slides made of cast steel (not cast to shape, but cut out of the solid) and united by a casting to which they are bolted. On the back of these slides works a pair of expansion-slides; each of these slides is provided with two horns, the horns of the one slide lying within the horns of the other, like the common arrangement in a dining-room expanding table, and so that (also like such a table) the slides can be moved in and out telescopically, and at the same time preserve their true and proper relation, as to level and surface.

On each of the slides there is a projection carrying a gun-metal nut free to move sideways, in which nuts the slide-stalk works.

This stalk is of steel, and has on it two triple-threaded screws, one for each nut.

The screws are of about $1\frac{5}{8}$ pitch, so that $\frac{1}{3}$ of a revolution of the slide-stalk will vary the length of the expansion-slides a little over half an inch at each end.

The slide-stalk works in a collar, and a pinion is passed over it, having a key taking into a slot in the slide-stalk, which pinion is worked by a sector (of a radius larger than that of the pinion) moved by the governor.

There is an adjusting screw to regulate the position of the sector in relation to the governor. As the governor balls fly out, they work the sector and pinion, to turn the slide-stalk, and thereby separate the slides, so as to cause them to cut off earlier. At the same time the governor raises a weight, attached to a cord passed round a pulley, having a feathered boss through which the stalk slides.

This weight causes the slide-stalk to revolve in the direction proper to shorten the slides, so as to diminish the expansion.

The sector before spoken of is not rigidly attached to the governor, but is driven through the intervention of a slot, and it is the weight alone which causes the slide-valve to be shortened, as the mere falling of the governor ball would, owing to the presence of the slot, have no effect whatever in shortening the slide.

The steam is taken by an internal steam-pipe, extending from the cylinder up into a steam-dome placed over the fire-box, in which dome there is the steam-regulator, or starting valve.

The exhaust steam, from the two ends of the cylinder, goes into a central belt cast round the cylinder. On the upper part of the belt a steam-blast nozzle is placed, while from the lower part a branch proceeds to convey steam into a flat steam-heater, bent round about the inside of the smoke-box.

In the steam-heater there are several feet run of $\frac{5}{8}''$ brass pipe; this pipe is surrounded by the waste steam, and in the pipe circnlates the water from the rising clack-box of the feed-pump. The heated water passes through a stop-back valve-box, into the boiler, through the front tube-plate of the boiler.

The exhaust steam which is condensed in heating the feed-water, escapes by a pipe at the bottom of the smoke-box.

The feed-pump lies at an angle, is bolted to the barrel of the boiler, and is worked off the eccentric provided for it. It is always drawing; the surplus water is returned to the feed-vessel; there is also a cock by which the water can be sent direct into the boiler without being heated.

The back end of the fire-box below the fire door is made without any water-space whatever, that is to say, that so far as the water space of the fire-box is concerned, the fire door is not merely an oval orifice, bnt is an opening extending from the very bottom of the box up to the arch over the door, which is of the usual semi-elliptical figure of a fire-door frame.

The space below the door is filled in by a cast-iron plate, lined with fire-bricks.

The Exhibitors attribute to this construction the advantage of getting rid of a cause of wear in the fire-boxes, as ordinarily made with a water space below the door, as they allege that it is in that part that fire-boxes most speedily give way; they also point out that this large opening is very convenient when it is necessary to do repairs inside the fire-box.

The bearing-wheels of the engine have wrought-iron spokes, and wrought-iron inner and outer rims; the spokes are cast into the bosses, as are also the boxes, which are chilled. The hind axle is of wrought iron carried in brackets attached to the fire-box; the fore axle is also of wrought iron, attached to the under side of a wood bed. This bed carries the wheel-plate, which bears against a wrought piece, fastened under the front part of the barrel of the boiler some little distance back from the smoke-box; in fact the fore axle is so placed that the front wheels just clear the hind ones in locking.

The barrel and fire-box are cleaded all over. The ash-pan and damper are of the usual construction.

This engine was tried twice; the double trial arose in the following manner:—

On the occasion of the first trial the engine ran for 4 h. 47 m. actual time, and for 4 h. 51 m. 18 s. mechanical time, representing a consumption of 2·884 lbs. of coal per brake horse-power per hour.

The quantity of water evaporated from 212° was 2319 lbs.

The engine was perfectly steady in its running, and the governor had it completely under control in the trial made in respect of that head of merit in an engine.

This being the state of the case, the engine of the Reading Iron Works Company (Limited) (No. 2927) was tried; the full particulars of this trial will be given when describing that engine, it will suffice here to state, that it ran for 4 h. 51 m. 36 s. mechanical time, giving a consumption of coal of 2·881 lbs. per brake horse-power per hour.

This result was so close to that obtained by Messrs. Clayton and Shuttleworth's engine, as stated above, that it was felt to be practically a "tie."

The two Exhibitors, therefore, were invited to repeat their trials; to this invitation Messrs. Clayton and Shuttleworth responded; the Reading Company preferred to rest upon the results they had already attained.

On the occasion of this second trial of Messrs. Clayton and Shuttleworth's No. 4942, the actual time of running was 4 h. 54 m., the mechanical time 5 h. 1 m. 6 s., giving a consumption of 2·79 lbs. of coal per brake horse-power per hour.

The water evaporated from 212° was 2314 lbs. = 11·81 lbs. of water per lb. of coal.

The Judges had hoped, after the remarks in the Wolverhampton Report on the inefficiency of the indicator arrangements made by some of the Exhibitors, that there would have been no cause for complaint at Cardiff; they regret to say, however, that this was not so, and that defective arrangements existed in this engine of Messrs. Clayton and Shuttleworth.

The pipes and cocks appeared externally all right, but the diagrams were manifestly all wrong, as they gave, on being worked out, an indicated power slightly below that of the brake horse-power.

Engineering readers may be tempted to ask how the Judges know that the fault did not lie with the indicator. The answer to this very natural question is, that the same indicator gave proper results from other engines, and that though the springs were repeatedly changed during Clayton and Shuttleworth's trial, no variation in the horse-power was obtained.

On taking off the cylinder cover, it was seen that the connections between the indicator pipes and the cylinder were little better than knitting-needle sized holes.

No remarks of the Judges can now cure this blunder, but they may prevent a repetition of it; and they may be useful in another way: they may make engineers, who are testing the power of engines by the indicator alone, unchecked by any dynamometer, extremely careful in providing proper fittings, and thus ensuring that the full power of the engine shall be recorded on the diagrams. Certain it is, that if Messrs. Clayton and Shuttleworth had not had the testimony of the dynamometer to their performance, the results afforded by their indicator cards would not have put their engine into even the second rank, far less would they have secured for it the First Prize (the 40*l.*) which the Judges awarded to it.

The next engine that was tried was that of Mr. Edward Hayes, of Stoney Stratford (No. 4834). Price 230*l.*

This engine has a cylinder of 9 inches diameter and of 1 foot length of stroke.

The boiler has a total heating surface of 170·6 square feet, and the fire-grate an area of 5·1 square feet, the whole of which was used at the time of the trial.

The Exhibitor elected to work at 8-horse power on the brake, at 70 lbs. pressure of steam, and at 130 revolutions.

This engine has the cylinder, which is not steam-jacketed, placed on the fire-box; the crank-shaft, a "bent" one of wrought iron, is carried on brackets, secured near to the fore end of the barrel of the boiler.

There is only a single slide, worked by an eccentric, and another eccentric is provided to drive the feed-pump.

The feed-water is heated by taking off a portion of the exhaust steam into the feed-tub.

The boiler is cleaded, the fire-box is naked. The boiler tubes are 36 in number and $2\frac{3}{16}$ bore; the result was that, although the engine was only developing 8-horse power (and therefore the consumption should have been small in proportion to what it would be when the engine was doing full work), the heat in the smoke-box was very considerably in excess of that of other nominal 8-horse power engines, which were being worked at as much as 14-horse power.

The bearing-wheels are wood, running on wrought axles.

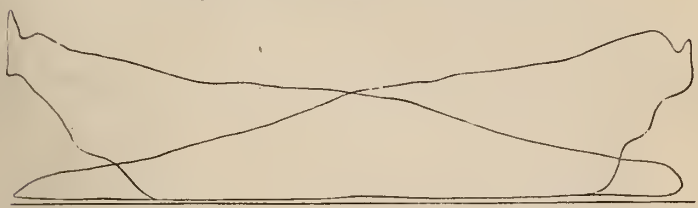
The governor could not control the engine at all; serious use of the hand-regulator was required.

The actual time running was 1 h. 28 m. 25 s. The mechanical time was 1 h. 23 m. 36 s., giving a consumption of just 10 lbs. of coal per brake horse-power per hour.

The gross indicated horse-power was 9·1, and the consumption of coal for each such horse-power was 8·30 lbs. per hour.

The temperature of the feed-water was about 120°.

Fig. 2.—*Indicator-Diagram of Mr. E. Hayes' Portable Engine, No.* 4834 (No. 3 diagram, 48 lbs. spring.)



The engine was so indifferently managed, that it was impossible to keep the water at the proper height in the gauge, and when the trial was ended it had disappeared from the glass. The water was probably at such a distance below the starting level as would have required about 16 gallons to fill up; this, added to the quantity noted (30 gallons) would give 46 gallons as the total evaporated, and of this the 30 gallons would be from *cold water*. The evaporation of these 30 gallons is treated as from *cold* water, because, in this instance, the steam which heated the feed-water became mingled with it, and had to be re-evaporated, and thus the effect was practically the same (so far as the *boiler duty only was concerned*) as evaporating from cold water. This point was noticed in last year's Report.

Such an evaporation is equal to about 50·9 gallons from 212°, equal to 4·54 lbs. of water per lb. of coal.

It would appear that the boiler did about one-half, or rather less than one-half, its duty in making steam, and that the engine did about one-half its duty in using it; thus a final result of nearly four times the least consumption of coal per horse-power per hour was reached.

The next engine in order of trial was (No. 4959) Davey, Paxman, and Co., of Colchester. Price 230*l*.

This engine has a cylinder $8\frac{5}{8}$-inch diameter, 1 foot length of stroke, a total heating-surface of 168·4 square feet, fire-grate of the full area of 3·75 square feet undiminished by fire-brick while running.

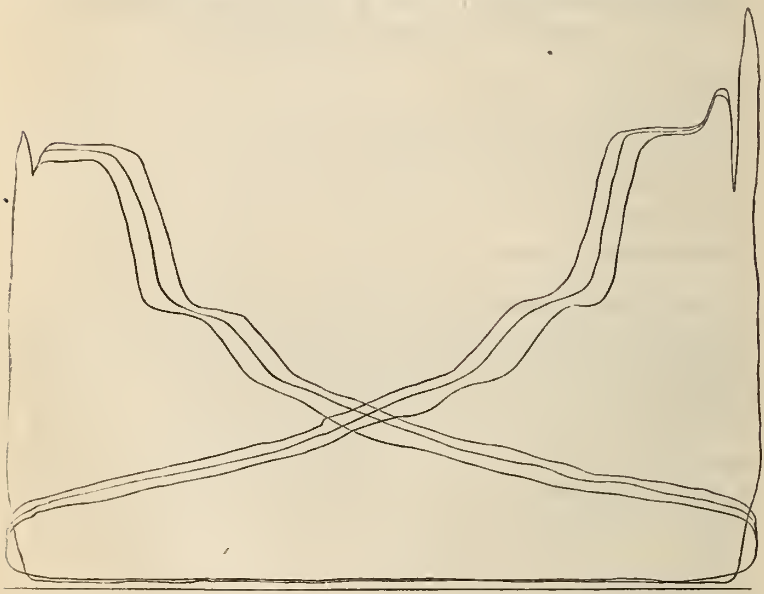
The exhibitors elected to run at 80 lbs. pressure, at 115 revolutions per minute, and at 12-horse-power on the brake.

This engine differs from the ordinary locomotive type, and it does so in this particular, that although the boiler is, as a whole, of the locomotive form, it has added to it in the fire-box, 10-2¼-inch diameter wrought-iron bent water-tubes, of the Davey-Paxman character, such as were introduced by this firm at Oxford (1870) in their 4-horse semi-portable. The upper ends of these tubes are provided with deflectors, to cause the current, as it rises through them, to be dispersed horizontally.

The cylinder is bolted on to the fire-box and is steam-jacketed, as also are the covers.

The crank-shaft, which is near the smoke-box, is supported in brasses, one pair of which are adjusted sideways, and the other pair, near the fly-wheel, are adjusted vertically. The brasses are supported in cast brackets bolted to the

Fig. 3.—*Indicator-diagram of Messrs. Davey, Paxman, and Davey's Portable Steam Engine, No.* 4959 (No. 8 diagram, 32 lbs. spring.)



boiler. The crank is a "bent" crank, and is made of steel. The engine is balanced at the fly-wheel.

The four guide-bars are cast iron.

The guide-blocks are also cast iron, and the adjustment for wear is made by letting the bars together.

The steam is admitted to the cylinder through a regulator, and then passes an expansion-valve into the slide-jacket.

The main slide is an ordinary short D slide. The expansion slide is a small gridiron valve, taking steam in over the end and through four openings. The travel of this slide is $\frac{5}{16}$ths. It is driven by the oscillating movement of a spindle, carrying a lever situated in the expansion slide-box, and having a gun-metal block on its end, which gives motion to the slide. The spindle does not pass through a stuffing-box, but has formed on it a small cone, ground in steam-tight. The cone is kept up to its seat by the pressure of the steam, and by a small brass spiral spring.

The spindle is caused to oscillate by a rod passing through guides, and carrying a friction-roller at its forward end. This forward end bears against a double steel cam, made on a gun-metal "sleeve," sliding on the crank-shaft.

The "times" of the cam are uniform for opening, but vary for shutting according to the endway position of the cam upon the shaft, and this position is regulated by the governor, with which the cam is connected by suitable levers. It will be seen that this is applying to a portable agricultural engine the governor and cam motion, devised, it is believed, originally by Field, and shown in the 1838 edition of Tredgold 'On the Steam-engine.'

The return-motion of the rod is produced by a spring, acting on a collar on the rod, and contained in a guide-box through which the rod passes; there is also an indiarubber buffer, to prevent concussion and noise. There is no throttle-valve or regulator, nor other implement than this gridiron slide, to be acted on by the governor to control the pace of the engine. Messrs. Davey, Paxman, and Co. point out that, as the main slide has a lap to it, ample time is given to open the expansion-slide, and thus the cam can be of easy curves on the opening sides, and that it is at the time of opening alone there is really a pressure of steam on the expansion-slide; whilst, when the slide has to close, it may be done very suddenly, because at that moment there is practically as much pressure of steam on the one side of the expansion-slide as the other, and thus very little suffices to close the slide.

The feed-pump is immediately under the crank-shaft, and is worked by its own special eccentric.

The regulation of the water is made by a cock in the suction-pipe, which draws from a pail in the usual manner. There is a branch inserted in the exhaust-pipe near the cylinder, with a stop-cock, by which a portion of the waste steam can be conveyed into the pail to commence the heating of the feed-water.

A pipe proceeds from the rising clack-box of the feed-pump. This pipe is made of copper, and is one inch in diameter; it circulates in the exhaust-steam pipe, which is of a flattened section, so as to lie in the thickness of the cleading on the top of the barrel of the boiler. There are $2\frac{1}{8}$ feet area of the copper-pipe exposed to the waste steam. The feed-pipe next passes into an annular wrought cylinder, placed in the root of the chimney and in contact on both sides with the heated gases as they pass up, before mingling with the exhaust steam, the nozzle for which goes through the interior of this cylinder.

The bearing-wheels have wrought-iron spokes, cast into bosses, and cast also into a rim of a T section. The bosses are cast on chills. The hind wheels are fitted on a wrought axle, attached to the front side of the fire-box, but cranked horizontally so as to bring the centre of the wheels further back than the forward side of the box. The front wheels are also fitted on a continuous wrought axle, fastened to a wooden bed. The perch-pin passes through a wrought piece, attached to the under side of the fore part of the barrel of the boiler.

There is a stay-rod to the bottom side of the perch-pin; the limit of locking is made by stop-plates.

This engine, on trial ran for 4 h. 20 m. of actual time, and for 4 h. 18 m. 12 s. of mechanical time, giving a consumption of 3·25 lbs. of coal per brake horse-power per hour.

The average temperature at which the feed-water entered the boiler was about 186°; the quantity that would have been evaporated from 212° was 1852 lbs., equal to 11·02 lbs. of water per lb. of coal.

The engine—although the governor, being very sensitive, "hunted"—worked with great steadiness, and in the subsequent trial, to test the efficacy of the governor regulation, behaved extremely well, the sliding-cam and the gridiron expansion-valve all acting properly, and keeping the engine under perfect control.

The consumption of coal, per indicated horse-power, was 2·85 lbs. per horse-power per hour, that horse-power being 13·66.

This engine was "Highly Commended" by the Judges.

The next engine which was tried was (No. 4894) by Messrs. Brown and May, of Devizes. Price 230*l.*

The diameter of cylinder of this engine is 7½ inches, the length of stroke 1 foot. Total heating surface 159·1 square feet. The fire-grate area 3·2 square feet.

The trial was made with the full area of this grate, no bricks being used.

Fig. 4.—*Indicator-diagram of Messrs. Brown and May's Portable Steam-Engine, No.* 4894 (No. 6 diagram, 32 lbs. spring).

The exhibitors declared to run at 80 lbs. pressure, at 135 revolutions per minute, and at 9-horse-power.

The cylinder is placed on the top of the fire-box. The crank-shaft, which is "bent" wrought iron, 3 inches in diameter, is carried on cast-iron brackets, attached near the front end of the barrel of the boiler in the ordinary manner. These brackets have the brasses placed at an angle, so that, as they are tightened down, compensation is given to both the horizontal and the vertical wear.

The steam is taken from the boiler by means of an internal steam-pipe, which extends along the length of the barrel, and has a continuous slot on its upper side. There are also two holes for the inlet of steam, made in the elbow placed near the front of the fire-box, to which elbow the horizontal pipe is attached. The steam then passes to a regulator, or starting-valve (which is a plain slide), and issues into the slide-jacket, in which are two short slides, joined by a rod, and two bridles.

These slides are cast iron, and have on their backs two cast-iron expansion valves, joined by a rod with two T's.

There are no means of altering the distance apart of the valves, but the variation in expansion is made from time to time, as may be required, by shifting the position of the expansion eccentric; this is done by means of a set screw passing through a plate, which drives the eccentric, and through a slot in the eccentric itself. Such a regulation, of course, can only be made when the engine is standing.

The cylinder and covers are steam-jacketed.

The governor acts upon an ordinary throttle-valve.

The feed-pump is bolted just alongside the smoke-box on to the water-heater (next to be described), the pump lies at an incline, and is worked by its own special eccentric. The feed is always being drawn, and the surplus water is returned to the feed-tub through a regulating cock. From the rising valve of the feed-pump the feed goes through an inch copper pipe, which circulates 5 times in a cylindrical beater, placed alongside the barrel of the boiler, through which heater the waste steam passes. The feed is delivered at the fire-box end of the heater into a pipe, attached to a check valve placed on the side of the fire-box, at which point the feed-water enters the boiler.

2. In this instance all the feed-water must be heated, as there is no bye-pass to let cold water direct into the boiler. The feed-heater is thoroughly cleaded, and, on the top, there is a chequer plate, which serves as a gangway, or standing place, for the attendant, when oiling the engine.

The bearing-wheels of this engine are of wrought iron, with cast bosses. The hind-wheels support a solid wrought axle, attached to the front end of the fire-box. The fore-wheels are on a wrought axle, bolted to a wooden bed. The perch-pin passes through a forging fixed to the under side of the barrel of the boiler, a little behind the smoke-box. There is a stay from the fire-box to the perch-pin, and there is a pair of locking-chains to limit the motion.

The boiler and fire-box are cleaded all over.

There is a closed ash-pan, provided with a damper, adjustable by means of a sector and thumb-nut.

This engine ran for 4 h. 8 m. of actual time, and for 4 h. 15 m. 36 s. mechanical time, giving a consumption of 3·29 lbs. of coal per brake horse-power per hour.

The consumption of coal per gross indicated horse-power was 3·02 lbs. per hour, that horse-power being 9·8.

The temperature of the feed-water was about 210°, and the quantity evaporated 1370 lbs., equal to 10·89 lbs. of water evaporated from 212° per lb. of coal.

On a subsequent trial for regularity of running it was found that the ordinary governor and throttle controlled the engine pretty fairly, but not thoroughly well.

It will be seen from the diagram that the slide was badly set. The exhibitors attribute this to carelessness in final adjustment at Cardiff.

The next engine was (No. 4991), by Messrs. Tasker and Sons, of Andover. Price 210*l*.

The diameter of cylinder is 9″, length of stroke 1 foot; total heating surface 158 square feet; total fire-grate area 4·7 square feet—at the time of trial the whole of this was in use, the grate not being diminished at all.

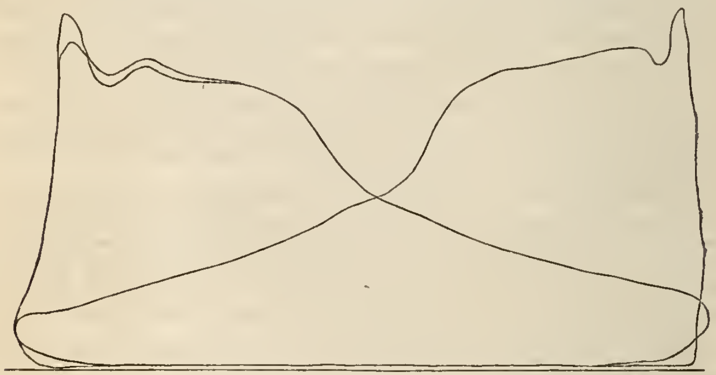
The exhibitors elected to run at 60 lbs. pressure, at 120 revolutions, and at 12-horse-power on the brake.

The cylinder is placed on the fire-box. It is steam-jacketed, as are also the covers. The crank-shaft is a "bent" shaft, 3 inches in diameter, made of S C crown. It is carried on cast brackets, bolted on the front of the barrel. One pair of brasses are adjusted sideways, while those near the fly-wheel are adjusted vertically, as well as sideways.

The four guide-bars are of wrought iron, case-hardened. The guide-blocks are of cast iron, with gun-metal wearing-pieces, and key-adjustments with set screws.

The steam is taken direct from the top of the fire-box into the cylinder jacket, which is always open to the steam. From this jacket it is admitted by a slide-valve regulator, or starting-valve, into the slide jacket.

Fig. 5.—*Indicator-diagram of Messrs. Tasker and Sons' Portable Steam-Engine, No.* 4991 (No. 2 diagram, 32 lbs. spring).



The principal slide is of cast iron, and is a long slide, made up of two short slides cast together into one casting; the exhaust from the two ends runs along the interior of the connecting casting to a central port in the slide, which travels opposite to a central eduction port in the cylinder facing. The whole length of the slide, except when two oiling grooves are chased across it, is in contact with the facing on the cylinder. On the back of this slide there are 2 cast-iron expansion slides provided with nuts, in which lie, right and left, screws formed on the stalk, so that the expansion can be adjusted by hand while running.

The engine is controlled by a governor and throttle-valve of the ordinary construction.

The feed-pump is worked by its own separate eccentric; and is bolted on the barrel of the boiler, not far from the fire-box. The pump is always drawing, and the surplus water is returned to the pail by a cock, which can be regulated by means of a long handle which extends within the fireman's reach as he stands at the fire-box. From the rising valve of the pump a pipe proceeds into an annular jacket round about the waste-steam pipe, which runs along the top of the barrel of the boiler above the cleading. From the end of this jacket (which, it should be said, is nothing more than a 3-inch pipe) continues the 2-inch exhaust pipe. The feed-water goes from this jacket into a bent heater, extending round the inside of the smoke-box. The heater is formed of boiler plate, and is, in truth, a water side to the whole of the smoke-box.

Near the upper part of the heater there are diaphragms, by which the water is made to circulate backward and forward through four horizontal wrought-iron pipes, which extend across the smoke-box, a little above the tube-level. From these pipes the water passes by a check-valve into the boiler, through the front tube-plate.

The bearing-wheels are of wood, the spokes being driven into sockets in the naves, which are cast iron, cast upon chill pins. The hind-wheels are carried on a wrought-iron axle bolted to the front side of the fire-box. The fore-wheels are on a wrought axle bolted beneath a wooden bed. The perch-pin passes through a forging fixed on the under side of the barrel, near the smoke-box. There is a stay from the bottom of the perch-pin to the hind axle, and there are a pair of chains to limit the amount of locking.

The barrel and fire-box are both cleaded, and the ash-pan is provided with a damper, regulated by a chain.

This engine on trial ran for 2 h. 45 m. of actual time, and 2 h. 50 m. mechanical time, giving a consumption of 4·94 lbs. of coal per brake horse-power per hour.

The consumption of coal per gross indicated horse-power was 4·36 lbs. per hour, that horse-power being 13·6.

The feed-water was raised to an average temperature of 164°, the quantity evaporated was 1568 lbs., equal to 9·33 lbs. of water evaporated from 212° per lb. of coal.

On the subsequent trial for regularity in running, it was found that the governor had the engine under fair control.

The next engine in order of trial was No. 2927, The Reading Iron Works Company, Limited. Price 235*l.*

This engine has a cylinder of 8½ inches diameter, and length of stroke 1 foot 2 inches, a total heating surface of 211 square feet. Total grate area of 7·2 square feet, of which a portion was stopped up by fire-brick, leaving an area of 2·37 square feet at the time of trial.

The exhibitors elected to run at 17-horse-power on the brake, at 140 revolutions, and at 80 lbs. pressure.

In this engine the cylinder is bolted on the top of the fire-box, and is jacketed, as are likewise the covers; the cylinder-jacket, however, is not made in the usual manner by cores in the casting, but is constructed on the plan pursued by this firm in their engines at the Oxford Show, a plan not then made public. This mode of construction consists, as already casually mentioned, in the insertion of a ⅜-inch thick steel bush, which really forms the working barrel of the cylinder; bands are left in the casting 2½ inches from each end, that is to say, deep enough to contain the projection on the cover, the steam port, and a ¾-inch bearing surface beyond the port; and it is into these 2½ bored bands that the turned exterior of the working cylinder is forcibly driven by hydraulic pressure. This process appears to make a thoroughly successful steam-tight joint between the cylinder and the bands.

The cylinder jacket is in direct communication with the boiler. The steam to work the engine is taken separately immediately from the top of the fire-box, and without any internal pipe. It passes by a starting valve into the slide jacket, in which there is a valve formed of 2 short slides cast together by an attachment piece. At the back of the valve, work two cast-iron expansion slides; these have on their backs saddles, in the form of half nuts, in which work right and left-handed double-threaded screws, formed on a gun-metal slide stalk.

The crank-shaft, which is 3⅝ in. diameter, is of iron, and is cut out of the solid; it is carried in two bearings, the one near the fly-wheel adjustable up and down, that near the cylinder adjustable sideways.

The bearings are supported on cast-iron brackets, bolted on to the barrel of the boiler.

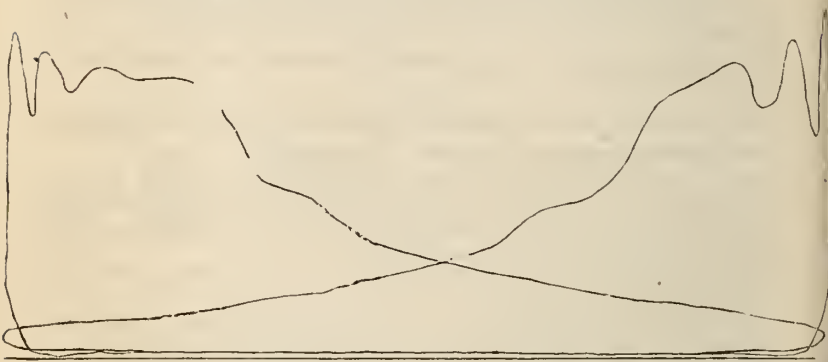
The guide-bars, four in number, are of cast iron; the guide-blocks are also of cast iron. The adjustment for wear is made by letting the bars together.

There are the usual two eccentrics, one for the main slide, and the other for the expansion.

The variation of the expansion is due to the action of the governor, which works the slide stalk by means of a toothed sector, the position of which, in relation to the governor, can be altered. The motion of the sector is given to a pinion on the expansion-slide stalk, and in this way the engine is regulated by the variation in the expansion. There is also a regulation from the same governor by means of a throttle-valve apparatus, which is of a peculiar construction.

The valve has a coil spring, in the nature of a clock-spring, attached to it, which always tends to keep it fully open. The arm on the spindle of the valve carries a pin, which is worked by the governor through a rod, terminating in a

Fig. 6.—*Indicator-diagram of The Reading Iron Works Co.'s Portable Steam-Engine, No.* 2927 (No. 4 diagram, 48 lbs. spring).



long slot, in which the pin lies. The governor makes far more than the necessary traverse for the mere moving of the throttle-valve from wide open to close shut, so that a small portion of the whole motion of the governor would suffice to effect the total motion of the valve. Advantage is taken of this construction, and in the following manner. Assume that it is intended to run the engine at such a speed that the governor balls will be so far out as to leave only a further ½-inch of motion in the collar of the governor, then the position of the slot is so adjusted (by means of a right and left-handed screw) that when the governor balls are in the position intended the valve is wide open, and there is no wire-drawing whatever of the steam; but, assuming the engine to go more quickly, and the balls to open out further, they will begin to close the valve, and if they went out to their extreme distance they would close it entirely. By this arrangement the engine can be set within considerable limits, to run with the full-open throttle, and yet to give the governor such control as will close the valve.

There is a further adjustment of the expansion; this is done by hand when the engine is standing, and consists in shifting the position of the expansion eccentric on the crank-shaft, which can be effected by means of a screw passing through a driving-disk fixed on the crank-shaft, and through a slot in the eccentric. By this means the expansion eccentric can be so placed as to give its quickest travel to the expansion slide at the moment of cut-off, and thus to make that cut-off sharp, and to prevent it from being lingering and wire-drawn.

The feed-pump is placed vertically under the crank-shaft, and is bolted on to a bracket on the barrel of the boiler; it is worked by its own eccentric, and is regulated by a cock in the suction. The pipe from the rising clack-box of the pump is jointed to a 1¼-inch copper pipe, which circulates backwards and forwards in a flat chamber, bent to the curve of the inside of the smoke-box. There are 30 feet run of this copper pipe in the chamber. From there the feed-water passes through a stop-back valve, and enters the boiler by the front tube-plate. The waste-steam pipe is for convenience brought through the barrel of the boiler, but, to prevent the injurious effects which would arise from passing a naked exhaust-steam pipe through an atmosphere of high-pressure steam, this pipe is encased in another, and between the two there is about an inch thickness of felt. When the waste-steam pipe reaches the smoke-box it divides, one branch goes upwards to give the blast, the other branch goes into the feed-heater previously described. The uncondensed portion of that steam which passes into the heater issues from the other end of it, and joins on to the first-mentioned portion, so as to add its volume to the blast of waste steam.

Both the slide-valve rods are guided in gun-metal bushes, four inches long, fixed in the wrought frame which carries the outer end of the guide-bars, and also carries the governor. The boiler is thoroughly cleaded all over. The internal fire-box is without any riveted seam, being welded up into one piece. There is the usual closed ash-pan with damper.

The bearing-wheels have wrought-iron spokes, cast into the bosses, and into the rims. These latter have each two internal feathers near to their edges, and thus are of that which may be called a double T section. There are bosses between the feathers to receive the outer ends of the spokes. The naves of the wheels are bored out, and have loose-bored cast-iron boxes fitted in, and held in by three bolts. The hinder wheels are fitted on wrought-iron axle arms, which are forged with large D-shaped ends, by which they are riveted to the side plates of the fire-box. The front wheels are also fitted on wrought-iron axle arms, that are fastened to the front bed. The whole of the fore carriage is of wrought iron, with the exception of the locking-plates, which are of cast iron. The perch-pin is carried in a forging attached to the under side of the fore end of the barrel of the boiler. The lower end of this pin is steadied by a stay to the front of the fire-box, and the amount of locking is regulated by locking-chains.

The performance of this engine has already been incidentally alluded to when describing engine No. 4942.

It may be well, however, to repeat here, that on the trial this engine ran for 4 h. 55 m. 30 s. actual time; and for 4 h. 51 m. 36 s. mechanical time, showing a consumption of coal of 2·881 lbs. per brake horse-power per hour.

The consumption of coal per gross indicated horse-power was 2·377 lbs. per hour, that horse-power being 20·58.

The average temperature of the feed-water was about 210°, the quantity evaporated was 2497 lbs., equal to 10·49 lbs. of water, at 212°, per lb. of coal.

The duty done by this engine was highly satisfactory, both as regards economical qualities and as regards its steadiness in the trials for governing capabilities; great intelligence and ability had obviously been bestowed upon the designing and carrying out the details of this engine.

The Judges awarded it the Second Prize, 20*l*.

It would not be right to close the notice of this engine without a word of commendation for its driver.

As is well known to the readers of this Journal, the management of the engines during trial is confided by the Exhibitors to men of great ability and experience in the art of driving; but, among them, the Judges believe the driver of this engine is entitled to a very high rank, and certainly nothing could exceed the steady, earnest, and unflagging attention which he devoted to his work.

The next engine for trial was (No. 4245) by E. R. and F. Turner, of Ipswich. Price 245*l*.

Like many other engines tried on this occasion, this had two fly-wheels; one, the working wheel used for transmitting power, the other the wheel containing the universal joint to suit the brake.

One of these wheels unhappily became unkeyed twice during the trial; it was therefore determined by the Judges that this precluded the engine from competing for the prize; but, at the request of the Exhibitors, and in order to ascertain its merits, the engine was suffered to make the trial.

This engine has a cylinder nine inches in diameter, and one foot length of stroke. It has a total heating surface of 187·8 square feet, and a total fire-grate area of 3·5 square feet, the whole of the area being used during the trial.

The Exhibitors elected to work at 80 lbs. pressure, to develop 20-horse-power on the brake, and to run at 180 revolutions per minute.

The cylinder is bolted on to the top of the fire-box, and is steam-jacketed, as is also the front cover; the back cover has an air space, but is left unjacketed in order to admit of the joint being broken whilst steam is up; the jacket is at all times open to the boiler.

The steam is collected by means of an internal pipe, running along the barrel of the boiler to the front end, and having, for about three feet of the front part, ½ in. holes in its upper side, about 20 in number.

It should be stated that the top of the fire-box is level with the top of the barrel.

The steam is admitted to the slide-jacket through an ordinary slide-regulator, or starting-valve.

The slide-jacket is bored out to receive the slide-valve, which is of the piston kind; this valve is hollow, and the steam passes from that end of the jacket, to which it is admitted from the regulator, through the body of the valve, to the other end of the jacket. At each extremity of the slide-valve there are two packing-rings of cast iron; these rings are pinned to the valve for so much of their circumference as is required to cover the passages into the cylinder, beyond these places the rings rapidly taper down and are left free to expand. The exhaust takes place in between the two ends of the valve, and round about the tube through which the steam passes. There is no expansion-slide, but the throw of this main valve is regulated by the governor acting on the eccentric; this action is obtained in a peculiar manner—a manner which it will probably be difficult to render intelligible by mere description—a sketch is therefore added (Fig. 7, p. 75).

On the crank-shaft "*a*," is keyed, by one of its sides only, a hollow disk, "*b*," containing the governor, and containing the attachment of the eccentric. The sheave, "*c*," of the eccentric (which takes the eccentric band) is outside the disk, "*b*;" this part of the eccentric has a slot, or oval space, "*d*," in it to allow the crank-shaft to pass freely through,—the connection of the eccentric not being in any way to the crank-shaft (as already stated), but to a point of attachment, "*f*," within the hollow disk keyed upon the shaft. There is a

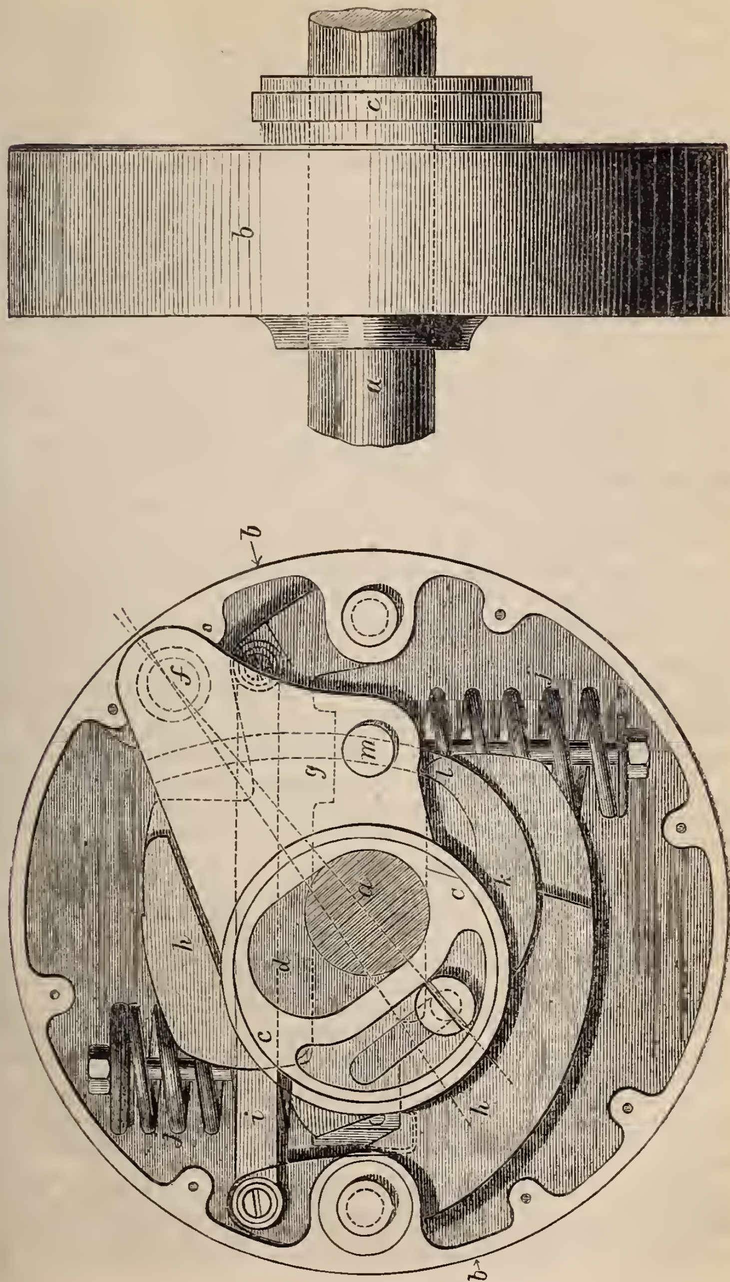


Fig. 7.—*Illustrating Hartwell's Patent Variable Expansion Governor fixed to Messrs. E. R. and F. Turner's Portable Engine, No. 4245.*

large central hole round about the crank-shaft in that side of the disk, close to the outside of which is the sheave, "*c*," of the eccentric; and through this hole a species of tail, "*g*," cast on the side of the eccentric sheave, passes into the cavity of the disk. The governor within the disk is composed of two weights, "*h h*," lying the one on the one side of the crank-shaft, and the other on the other, and so coupled by a link, "*i*," that in whatever position the governor may be one weight always balances the other. On the engine being put in motion the centrifugal force tends to drive these weights outwards, and would do so freely were it not for two powerful springs, "*j j*," one of which is in connection with each weight. These springs replace the effect of gravity in an ordinary governor, and keep the weights from too readily flying out, and also serve to give the return force to the governor, when the engine slackens its speed. To one of these weights is attached a piece of iron, "*k*," with a curved end, "*l*"; this end passes through a slotted pivot, "*m*," in the tail, "*g*," by which the eccentric is suspended from the pin, "*f*," in the disk. As the weights move outwards, under the influence of the quick revolutions of the engine, they take with them this piece of iron; and the curved end, in its traverse (it being set at an angle in relation to its path of motion) acts as an incline to shift the eccentric. If the engine be in head-gear it shifts the eccentric from the extreme position of that gear towards the centre; the more nearly it approaches the centre the less is the throw of the slide (the lead remaining, however, nearly constant) and the sooner is the steam cut off, while at the very centre the eccentric is immediately opposite the crank-pin, and there will be no admission of the steam whatever, except, as in the case of a link motion, that due to the lead.

If it is desired to reverse the engine for any reason, preparation for this must be made before starting, as it cannot be done while running. The reversal is effected by shifting the position of the curved piece of iron, by means of set-screws, so that the inclination to its path shall be left-handed, instead of right-handed; and thus, when the engine is at rest, the eccentric is found on the opposite side of the centre to that on which it was when the engine was set for going ahead; so that on the governor-weights flying out the reversed inclination of the curved piece of iron causes the eccentric to depart from its extreme position in stern gear, towards the centre, as formerly it caused it to depart from its extreme position in head gear, towards the centre.

The crank-shaft is a "bent" one, $3\frac{1}{8}$ in. general diameter, but $3\frac{1}{4}$ in. at the crank-pin, and is supported in two gun-metal bearings; the one on the fly-wheel side is adjustable horizontally, the one on the crank side is adjusted vertically.

These gun-metal bearings are carried in wrought-heads, bolted to angle-irons, riveted to the barrel of the boiler; the heads are placed with the flat surfaces in such a direction as to admit of their slightly bending, when the boiler expands under heat. The wrought heads have welded to them wrought-iron tie-bars, which extend back to the cylinder to lugs, upon which, and upon the slide-jacket, they are bolted. These wrought tie-bars carry a cross frame, which supports the outer end of the guide-bar. There is only a single guide-bar, which is below the piston-rod. This bar is of wrought iron, and is embraced by a cast-iron guide, made in an upper and a lower part, with capacity for adjustment.

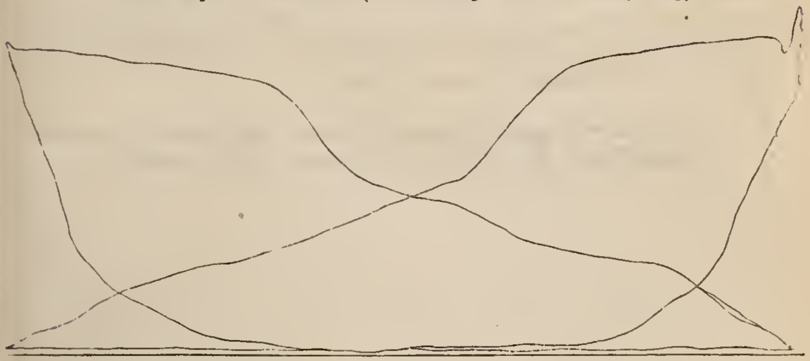
The Exhibitors point out that by the previously described arrangement, the engine is entirely self-contained, and wholly independent of support by the boiler, except so far as the mere carrying of the weight of the engine is concerned.

The feed-pump is immediately under the crank-shaft; it is worked by its own eccentric; it is always drawing, and returns the surplus water into the feed-pail. There is in the return pipe below the regulator (which is a screw-valve and not a cock) a steam nozzle in connection with the exhaust-pipe, so that, as the surplus water returns into the pail, a portion of the exhaust steam blows through the middle of it, and heats it as it goes back.

The exhaust pipe enters the side of the smoke-box, turns up in that box, and terminates very considerably below the base of the chimney, the diameter of the orifice being as much as $2\frac{7}{8}$ in.

It has been a matter of surprise to the Judges (a surprise that has been expressed on several occasions to exhibitors) that a body of men who have laboured so diligently to improve the portable engine, should not, in the matter of the blast-pipe, take example from locomotive practice. In locomotives, for many years past, the improvements in obtaining a steady, uniform, and

Fig. 8.—*Indicator-diagram of Messrs. E. R. and F. Turner's Portable Steam-Engine, No.* 4245 (No. 2 diagram, 45 lbs. spring).



powerful draught, coupled with a large orifice of the exhaust nozzle, have been known to be in a great measure due to the change that has been made in the position of the nozzle; a change which brought its delivery from out of the base of the chimney to a position in the smoke-box, just above the top row of tubes.

The Judges are glad to see that Messrs. Turner recognise this fact.

The bearing-wheels are of wood, the spokes being driven into cast-iron naves —these naves are cast on chill pins; the hind-wheels are on a wrought-iron axle extending along the front of the fire-box; the fore-wheels are also on a wrought-iron axle. There is not any wooden bed, but a cast locking-plate is carried on the top of the axle; and a bearing-plate, made of a suitable form, and of wrought iron, is fixed on the under side of the barrel of the boiler; below this plate there is a casting, terminating in a spherically-shaped face, which bears on a cup, formed in the cast plate on the top of the axle.

There is, as has been already stated, a wheel on each end of the crank-shaft, each wheel containing counter-balances to the crank, so placed as to bring their joint effect immediately opposite the crank-pin.

This engine ran for 3 h. 52 m. actual time, and for 3 h. 51 m. mechanical time, equal to a consumption of 3·63 lbs. of coal per brake horse-power per hour.

The indicator diagram (Fig. 8) given above shows the effect of cutting off with a single slide, driven off the equivalent of a link motion.

The consumption of coal per gross indicated horse-power was 2·9 lbs. per hour, the horse-power being 24·9.

The feed-water was heated up to about 162°, the quantity evaporated was 2780 lbs., equal to 9·93 lbs. of water, at 212°, per lb. of coal.

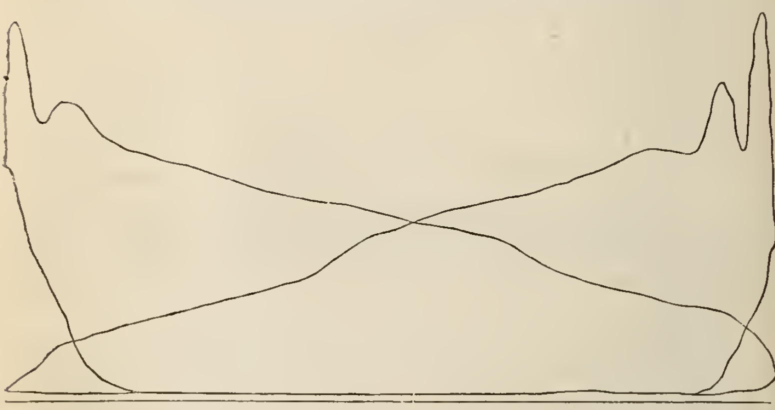
On the trial for ability of governing, the results were found to be very satisfactory; not only was the engine under the most perfect control, but the variation in speed did not amount to 4 per cent. between the pace due to the full load, and that arising from working against no resistance except the trifling friction of the engine and brake.

The Judges felt that this successful expansive governing arrangement was peculiarly one of those cases for which the Silver Medals were intended, and they therefore, in accordance with the regulations, sought for, and obtained, the approbation of the Stewards to their awarding to the Exhibitors a Medal for "Hartwell's Patent Variable Expansion Governor."

The next engine that came to trial was that of Barrows and Stewart, of Banbury (No. 2950). Price 230*l.*

This engine had a cylinder of 9½ in. diameter, and 1 ft. 1 in. length of stroke, a total heating surface of 129·8 sq. ft., and a fire-grate area of 5·02 sq. ft.—the whole of the area being used at the time of trial.

Fig. 9.—*Indicator Diagram of Messrs. Barrows and Stewart's Portable Steam-Engine, No.* 2950 (No. 4 diagram, 32 lbs. spring).



The Exhibitors elected to run at 120 revolutions per minute, at 12-horse-power on the brake, and at 70 lbs. pressure of steam.

The cylinder is bolted on to the top of the barrel, near the smoke-box end, is not steam-jacketed, except for about half its circumference, and this is done by the steam on its way to the slide-chest. The cylinder-casting also contains the slide-jacket, the starting-valve box, and the throttle-valve. There is not any expansion-slide. The single slide is worked by an eccentric in the ordinary manner; the throttle-valve is worked by the governor. The feed-pump derives its motion direct from the piston-rod cross head, and is supported by flanches alongside the cylinder, and under the lagging; it is of gun-metal.

The exhibitors claim for this construction simplicity, and a diminution of the number of attachments to the boiler. The governor is of the ordinary type, but it is rendered more sensitive by the addition of a spiral spring round about the spindle.*

* The question of the sensitiveness of governors is touched upon in the concluding remarks.

The crank-shaft is carried in two cast-iron brackets, bolted to the boiler over the fire-box. The brasses in those brackets have, on the fly-wheel side, a vertical adjustment, and on the opposite side they are in three pieces with a horizontal wedge adjustment. The crank-shaft is of the "bent" kind, and is of wrought iron.

The guide-bar is a single one, slotted down the middle, attached to the cylinder stuffing-box at one end, and to a bracket fast to the boiler at the other. Through the slot is an arm, which connects the cross-head to a guide-block bearing on the under side of the guide-bar. This guide-block has a lug pointing downwards, which gives motion to the feed-pump plunger. The pump is easily inspected, it is provided with a flexible suction-pipe to dip into the feed-water pail. The pipe from the rising clack-box is carried alongside the boiler to near the smoke-box end, where it enters the boiler through a check-valve. There are no means of heating the feed.

The bearing-wheels are of wood, with iron tyres. The hind-wheels are fitted to a wrought axle, bent to pass beneath the fire-box, to which it is attached by brackets. The fore-wheels are fitted to an axle secured to a wood bed. There is a flanged iron bracket, riveted to the under side of the boiler at the smoke-box end, which carries a perch-pin; the bottom of this pin is stayed to the fire-box, and there are two chains to regulate the amount of locking.

This engine, upon trial, ran for 2 h. 30 m. actual time, and for 2 h. 25 m. 6 s. mechanical time, giving a consumption of 5·78 lbs. of coal per brake horse-power per hour. The indicator diagram shows that 14·27 gross indicated horse-power were developed, making a consumption for each such horse-power of 4·87 lbs. of coal per hour.

The feed water was cold when pumped in, the quantity evaporated was equal to 1506 lbs. at 212°, equivalent to 8·97 lbs. at 212° per lb. of coal.

On the trial of the engine to ascertain the power of the governor, it was found that the engine was under fair control.

The last engine which was tried was that of Messrs. Ashby, Jeffreys, and Luke, of Stamford (No. 4004). Price 230*l*.

The cylinder is 9½ inches diameter, by 1 foot 2 inches stroke. The total heating surface is 204·5 feet. The total fire-grate is 5·5 feet, but this was reduced, by fire-brick, during the trial to an area of two square feet, in two sections of 1 foot each.

The Exhibitors determined to run at 120 revolutions per minute, at 8-horse-power, and at 80 lbs. pressure of steam.

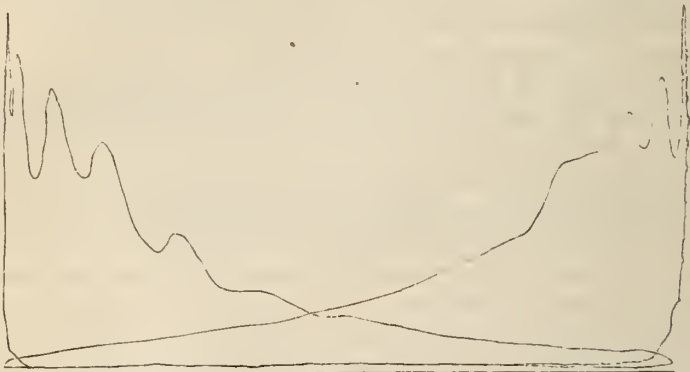
The cylinder is bolted upon the fire-box; it is jacketed all round its circumference, and at the ends. The crank-shaft is of the "bent" type, and is made of wrought iron; it is carried in bearings supported by two horns on a single broad casting, bolted to the top of the boiler, at the smoke-box end. The bearings have adjustment for endway wear. On the back of the main slide-valve, which is composed of two short slides coupled by bolts, there is an expansion slide of similar construction.

The governor is of the ordinary kind, working an ordinary throttle-valve. The guide-bar is a single one of wrought iron. The guide-block is of cast iron, working upon the bar, and flanged round to grasp its under side at the edges.

The exhaust on leaving the cylinder passes through two pipes, which embrace the barrel of the boiler as far as the under side, where these pipes turn longitudinally, and enter into two 2½ tubes, which convey the exhaust to the blast-pipe in the smoke-box. Inside these tubes are two 1½-inch pipes conveying the feed on its way from the feed-pump to the boiler. The pump is worked by an eccentric on the crank-shaft. The pump-valves work in conical seats, and have conical faces, and these cones are prolonged below the valves till they terminate in points. The Exhibitors attribute to this form a more easy entrance for the water. The bearing-wheels are of wood. The axles for the hind-wheels are supported in cast-iron brackets, bolted to the fire-box.

On trial the engine ran for 1 h. 48 m. of actual time, and 1 h. 52½ m. of mechanical time, the coal used being 7·47 lb. per brake horse-power per hour. The indicator diagram shows a development of 12·15 horse-power,

Fig. 10.—*Indicator-diagram of Messrs. Ashby, Jeffery, and Luke's Portable Steam-Engine, No.* 4004 (No. 1 diagram, 48 lbs. spring).



equivalent to a consumption of 4·92 lbs. of coal for each such horse-power. The great disparity between the brake and the indicated horse-powers, viz., as 2 to 3, it is believed arose in a large measure from sand of the cores having been left in the steam passages, and then being driven from them into the cylinder.

The temperature of the feed water was not taken. The quantity evaporated was equal to about 1146 lbs. at 212°, being at the rate of 9·27 lbs. per pound of coal.

For the purposes of easy comparison, the leading dimensions of the different engines, and also the results of the trials, are exhibited in the following Tables I. and II., prepared by Messrs. Eastons and Anderson, the Consulting Engineers of the Society.

The Judges look upon the results which these Tables show as highly satisfactory in many cases, and as reflecting in those cases the greatest possible credit on the engineers, to whom such results are due.

The professional duties of the Judges have caused them to be intimately acquainted with the progress and attainments of the marine engine, of the locomotive, and of the fixed engine, used for manufacturing purposes, and with those of the engines employed for pumping water; and they have no hesitation in saying, that agricultural engineers may fearlessly challenge for their work, comparison with any one of these other products of engineering science and skill.

The Cornish pumping-engine used to be looked upon as the most economical of all. The Monthly Report for June last shows that their average duty in that month was 53·3 millions of pounds raised 1 foot high by the combustion of 1 cwt. of coal, and that the duty of the best engine was 71·7 millions of pounds.

These sound like very large figures, very much as a sum stated in francs appears enormous, until the proper divisor is applied to bring it into pounds sterling, and then the bulk vanishes, and one is enabled to judge of the amount in relation to other sums with which one is familiar.

When this reducing test is applied to the Cornish engine coinage, it will be found that 71·7 millions of pounds lifted 1 foot high for a cwt. of coals, means 3·09 lbs. of coal per horse-power per hour, a quantity rather over ¼ lb. per horse-power per hour more than that which was burnt by the most economical engine tried at Cardiff; and it must be remembered that not only is this best Cornish engine working with the aid of condensation, giving a vacuum of probably 13 lbs. on the square inch, but that it has an 80-inch cylinder, and 9 feet stroke, so that the cooling surfaces of the cylinder, and the piston friction, and other frictions, are considerably less relatively to the size of the engine, than they can be in a portable with its 9-inch cylinder and 1 foot of stroke.

Following up the Cornish engine comparison it may not be amiss to point out, that two of the engines tried at Cardiff gave duties above that of the *best* of the engines in the June Cornish Report, viz., 79·49 millions, and 76·64 millions, as against 71·7 millions, and that the *average* duty of the engines tried at Cardiff was 57·09 millions as against 53·3 millions the *average* of the Cornish.

Recent improvements have brought the marine steam-engine down to as low a consumption as 2 lbs., or under, per Indicated horse-power per hour; but here again the engines are of large size, have the great advantage of condensation, and that a surface condensation, and in many cases the advantage (or supposed advantage) of compound cylinders.

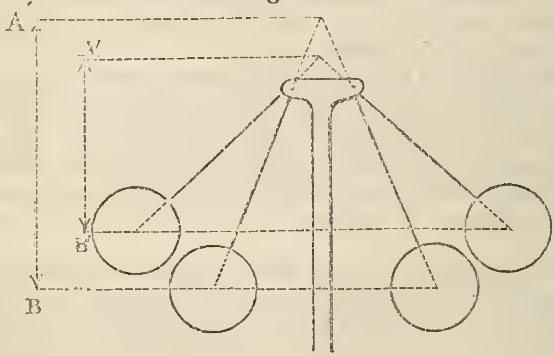
The consumption of the most economical engine tried at this show, of which successful indicator diagrams were obtained, the engine of the Reading Ironworks Company (Limited), was as low as 2·377 lbs. per Indicated horse-power per hour; a consumption which will bear favourable comparison with the best modern marine engines, when it is remembered that those engines condense their steam, and are of large size.

The Judges will take the liberty of throwing out, in conclusion, one or two suggestions, and they do so with the more confidence, because they know that these Reports are really studied by their engineering brethren, and that such well-founded observations as are made in them are weighed and acted upon.

The first of these suggestions is, as to whether some ready means should not be devised for enabling the feed-heater to be cleaned out; if this were done, the feed-heater would not only do good duty in heating the feed-water when all was new and in good order, but would continue to do such duty, and would act as a valuable trap to receive a portion of the lime, which otherwise would be deposited in the boiler.

The second of these suggestions is, that to obtain really sensitive governing of the engine, the governors, instead of being driven only at the engine speed, or even below the engine speed, as they were in many instances at this show, should be driven at a higher velocity, so as to open rapidly on a small increase in speed, and should be provided with springs to quicken the action of gravity, in returning them on a diminution of the velocity of the engines; and further, that for real uniformity of work, the arms should never be pivoted on pins placed between the spindle and the ball (as in Fig. 11), as such a position for

Fig. 11.



the pivot tends to most materially diminish the vertical height AB as the balls fly out; because whilst the ball rises from B to B′, and thus diminishes that height, the produced line of the centres of the arm falls from A to A′, and causes a still further diminution.

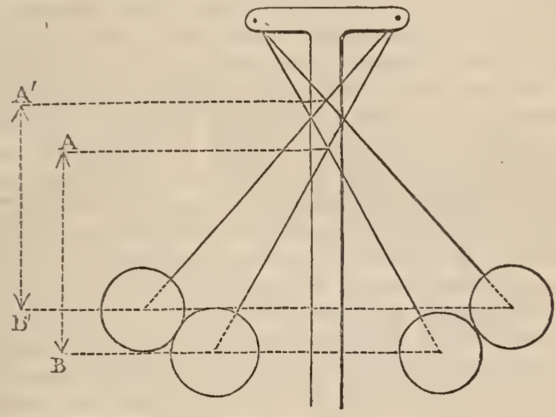
To promote uniformity, the pivots should be on the side of the spindle away from the balls, as in Fig. 12 (the spindle being slotted to allow of the passage of the arms), as by that arrangement the point of intersection of the arms of the governor-ball with the spindle rises as the balls rise, and thus the height A′ B′ is kept much more nearly equal to the height AB.

The third, and by far the most important point, to which the Judges have to call attention, relates to the firing.

There can be no doubt that a large portion of the great success of the engines on this occasion arose from the high evaporative duties got out of the boilers.

The analysis of the Llangennech coal shows that its theoretical

Fig. 12.



power of heating amounts to 15·24 lbs. of water, evaporated from 212°, for each pound of coal burnt (see Appendix).

That a duty of even so much as 11·83 lbs.* of water should have been obtained, proves, not merely that the heat generated must have been largely utilized by the boiler, but also that the greater part of the coal must have been completely burnt, and that this must have been done without the admission of any considerable excess of air.

The Judges may perhaps be pardoned for reminding some of their readers that it is possible so to deal with coal, or coke, in a fire, that a large portion of it shall escape unconsumed up the chimney, and shall do this without the appearance of smoke.

Assuming a fire to be fed with insufficient air, this is what takes place. The air coming in contact with the fuel imme-

* In the instance of the steam-jacketed cylinders, the steam condensed in their jackets passed back direct into the boilers, and thus escaped actual measurement; this water of condensation had, however, to be re-evaporated by the boilers, just as much as if it had been visibly mingled with the feed water, and thus the evaporative duties of the boilers of jacketed engines are a trifle in excess of those given in Table II.

diately above the bars burns it, and forms carbonic acid ; but this carbonic acid, in passing up through the layer of fuel above, dissolves, as it were, that fuel, and takes out of it an equivalent of carbon, so as to bring this carbonic acid back to the state of carbonic oxide, a highly combustible gas. But if this carbonic oxide cannot obtain air above the fire, it goes away unconsumed ; and when it is considered that a pound of carbon, which would evolve 14,000 units of heat, if it were all turned into carbonic acid, will only evolve 4000 units of heat if the carbonic oxide stage alone be reached, it will be seen how necessary it is to effect the perfect combustion of the fuel. On the other hand, if, with the view of ensuring this, an excess of air be admitted through the fire, that air has to be heated from the temperature of the atmosphere to that at which it enters the chimney, and this heat is all so much waste. These considerations show the great importance of having the most perfect regularity of fire.

During the trials, this regularity is obtained by the employment of men who exhibit the highest skill and diligence in attending to the firing. In order to preserve uniformity, they fire from thirty to forty-five times in the hour, but clearly in practice no man could so attend to a fire ; he would be worn out with the labour, and even if he could endure the toil, the user of the engine could not afford that a man's time should be exclusively occupied in this way ; and thus, however high the results may be that are developed by a boiler on trial, these results must fall off in actual work. But if agricultural engineers would turn their attention to devising some simple kind of mechanical firing, by which uniformity of distribution should be ensured, it is believed that the most beneficial results would follow, and that in the practical use of the engine, a very high evaporative duty would be at all times maintained, while the engine-driver would be left at liberty to attend to other work.

In concluding this Report, the Judges are happy to be again able to thank all the Exhibitors for the cheerful manner in which they attended to the Judges' wishes ; and they have also to thank the Stewards for their courteous and valuable aid and assistance.

(Signed) F. J. Bramwell, 37, *Great George Street, Westminster.*
W. Menelaus, *Dowlais.*

APPENDIX.

On the Composition and Calorific Power of Llangennech Coal.

DURING the trials at Wolverhampton, in 1871, the question arose, "What is the relative value of the Llangennech coal, used for many years past in the Society's trials of steam machinery, compared with other first-class steam-coal?" Mr. Menelaus, C.E., of Dowlais, one of the Engineer Judges of Implements, having kindly offered to have an analysis made of the coal, the Consulting Engineers, on the part of the Society, gladly accepted his offer, and selected an average sample from the stores for the purpose. Mr. Menelaus placed it in the hands of Mr. Snelus, analytical chemist at the Dowlais Iron-works, and, on receipt of his Report, forwarded it to Messrs. Eastons and Anderson. As the comparative value of the fuel used is necessarily of interest to numerous members, the Report, and a few remarks by Mr. Menelaus on the coal, are, by his permission, published *in extenso*:—

"Laboratory, Dowlais Iron and Steel Works,
"*August* 25*th*, 1871.

"*Report upon Sample of Llangennech Coal used by the Royal Agricultural Society at Wolverhampton.*

"*To* WILLIAM MENELAUS, *Esq.*

"DEAR SIR,—I have completed the examination of this sample of coal, and find it to contain, by ultimate analysis—

Carbon	84·97
Hydrogen	4·26
Nitrogen	1·45
Sulphur	·42
Oxygen	3·50
Ash	5·40
	100·00

"It yields 86·7 per cent of coke.

"The ash is of reddish colour and consists of—

Peroxide of Iron	36·61
Silica	13·71
Alumina	11·61
Oxide of Manganese	·50
Lime	16·92
Magnesia	13·37
Sulphuric Acid	4·31
Phosphoric Acid	·91
Alkalies, loss, &c.	2·06
	100·00

"The calculated calorific power of such coal, taking the most recent determinations of thermal equivalents, viz.,

Carbon	8,080*
Hydrogen	34,000
Sulphur	2,220

and assuming all the sulphur to exist as iron pyrites (which is not strictly true but near enough for these calculations), shows that one part of the coal is capable of raising 8177 parts of water from 0° to 1° centigrade.

"Comparing this with the calorific power deduced in the same way from some of the other coals examined by the Admiralty Commission in 1848, I find that it ranks high, but that there are several other coals which are much superior,—

e.g. Ebbw Vale gives a calorific power of	..	9011
Powell's Duffryn ,,	..	8731
While Graigola gives only ,,	..	7867

The latter is of the same class as Llangennech.

"The following table shows the analyses of these coals with the actual duty obtained in the Admiralty trials, and it will be seen that there is a close correspondence between the relative calculated calorific powers and the actual duty obtained, so that where the direct experiment cannot be made, the chemical analysis affords a pretty safe guide to the value of a coal. On comparing my results in 1871 with those obtained by Sir Henry de la Beche and Dr. Lyon Playfair in 1848, it will be found that there is a close correspondence, thus showing that a careful chemical analysis is able to identify a particular class of coal, and also that seams of coal maintain their characteristics over considerable areas.

The trials by the Commission in 1848 and my own analysis agree in showing that the coal is surpassed by other steam coals of this district, both theoretically and practically.

"In the Report by the Commission the coal is described thus: 'These coals have a rather dull appearance, are soft, and have a structure almost wholly fibrous. Their fracture is very irregular, and the natural softness of the coals renders them easily reduced to powder.'

"This latter fact would account for the large quantity of so-called 'soot' found in the flues, which amounted to 225 lbs. from 7682 lbs. coal employed, and, as a necessary consequence, for the actual duty being lower than that given by some coals of inferior composition.

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* These are French thermometrical degrees of heat into English pounds of water, and must be multiplied by 1·8 to compare with the ordinary English expressions.

"It will be noticed that the sulphur in this coal is low, but that the ash is rather high. It yields but little 'tar,' and a moderate quantity of 'gas' by distillation.

"I am, dear Sir,

"Yours obediently,

(Signed) "Geo. J. Snelus, A.R.S.M."

Ultimate Analysis of Coals, with their Theoretical and Actual Value.

Class of Coal.		Carbon.	Hydrogen.	Nitrogen.	Sulphur.	Oxygen.	Ash.	Coke.	Calculated Calorific Power.	Actual Duty obtained, that is, lbs. of Water evaporated by 1 lb. of Coal.
Ebbw Vale	1848	87·78	5·15	2·16	1·02	·39	1·50	77·5	9011*	10·21
Powell's Duffryn	1848	88·26	4·66	1·45	1·77	·6	3·26	84·2	8731	10·15
Llangennech	1848	85·46	4·20	1·07	·29	2·44	6·54	83·69	8237	8·86
Llangennech	1871	84·97	4·26	1·45	·42	3·50	5·40	86·7	8177	
Graigola	1848	84·87	3·84	·41	·45	7·19	1·50	85·5	7867	9·35

In his letter to the Consulting Engineers enclosing Mr. Snelus's Report, Mr. Menelaus says :—

"The 'Ebbw Vale coal' may be taken to represent the Monmouthshire steam coals, and 'Powell's Duffryn' represents the Merthyr and Aberdare coals, which are so highly esteemed for locomotives and ocean steamers.

"The 'Ebbw Vale coal,' as you will see, is equal in calorific value to 'Powell's Duffryn,' or is perhaps even a little superior, but the Merthyr coals have the great merit of being smokeless.

"The Llangennech coal may be considered a very good steam coal, inferior to the best Welsh, but considerably above the average steam coals of England.

"It is, of course, somewhat smoky, but I do not think the Royal Agricultural Society can do better than to continue the use of this coal in their experiments."

With regard to the above analysis the Consulting Engineers to the Society make the following remarks :—

The sample of Llangennech coal submitted for analysis was not a picked sample, but a fair average of large and small taken

* See foot-note on preceding page.

from the coal stores. It is probable, therefore, that the relative value assigned to this coal is rather under than over the mark, as samples for experiment are too often picked.

It is very convenient to express the gross calorific power of fuel, in the weight of water at the boiling point, which an unit of weight of that fuel would evaporate at the same temperature, in an absolutely perfect boiler. The same figures, then, express the power under all standards of weights and measures.

Reduced to this standard of comparison "Llangennech," compared with those above referred to and other fuels, stands as follows:—

Theoretical Evaporative Power in lbs. of Boiling Water evaporated per lb. of Fuel.

Llangennech Coal (R.A.S.E. sample)	15·24
Ebbw Vale Coal (Admiralty Experiments)	16·8
Powell's Duffryn ,, ...	16·3
Best Aberdare supplied in London	15·9
Best Newcastle Steam Coal, about	15·0
Coke	13·0
Dry Peat	10·0
Dry Wood	7·5
Petroleum, about	22·0

These figures become useful for considering the efficiency of boilers, by comparing the water at 212° actually evaporated into steam per lb. of coal with the amount, according to the above figures, which would be evaporated in a theoretically perfect boiler; for it is not fair to judge of a boiler by the water evaporated, unless the quality of the coal is also considered.

As an example, the average weight of cold water evaporated in the ploughing engine boilers per lb. of coal during the trials at Wolverhampton was 7·2 lbs., which is equivalent to 8·6 lbs. of water at 212°, evaporated per lb. of coal. The theoretical power of Llangennech coal is 15·3, consequently the average efficiency of the ploughing engine boilers was $\frac{8 \cdot 6}{15 \cdot 24} = \cdot 56$; in other words, the furnaces and boilers rendered available ·56 of the absolute power latent in the fuel.

Similarly as regards the traction engine boilers, those of the locomotive type showed an efficiency $= \frac{9}{15 \cdot 24} = \cdot 59$, while the Thomson pot boilers gave efficiency $\frac{7 \cdot 6}{15 \cdot 24} = \cdot 5$.

III.—*Report of Experiments on the Growth of Barley for Twenty Years in succession on the same Land.* By J. B. LAWES, Esq., F.R.S., F.C.S.; and J. H. GILBERT, Ph.D., F.R.S., F.C.S.

IN volumes viii. xii. and xvi. of the first series of this Journal, we gave some account of experiments on the growth of Wheat year after year on the same land; in volume xxv. (1864), we published a detailed Report on the growth of the crop, without manure, and with different descriptions of manure, for twenty years in succession on the same land; and the twenty-ninth crop has now been harvested. In volume xviii. (1857), results on the growth of Barley, under somewhat similar conditions of manuring, for six years in succession on the same land, were given. Those experiments have been continued up to the present time, and are still in progress; and we are now enabled to record the results obtained with barley, as already with wheat, over twenty consecutive seasons.

Barley is, at any rate through the greater part of England, if not throughout Scotland and Ireland, the second in importance of the cereal grains we cultivate; in some localities, indeed, it is of first importance. It is a prominent element in the well-known four-course rotation, and is more or less prominent in almost every rotation throughout the greater part of the British Isles. Moreover, it is supposed that the characters and the condition of land under which it can be advantageously cultivated are greatly limited, and that its market value is much influenced, by certain fiscal arrangements. From various points of view, therefore. exact knowledge of the quantity and quality of the produce it yields, on a soil of a given description, but under a great variety of well-defined conditions as to manuring, and in seasons of very various characters, cannot fail to be of great practical interest.

The conditions of growth of barley, are, in some respects, very similar to those of wheat; but in others they are very different. Thus, as a rule, wheat is sown in the autumn, but barley not until the spring; and it has, therefore, much less time for the distribution of its roots, and for getting possession of the stores within the soil. Again, the descriptions of soil which are the most suitable for the growth of wheat, are generally not equally well adapted for the growth of barley. Hence, apart from the importance attaching to the barley-crop as a prominent and independent element in most of our rotations, the question of the degree in which the requirements and results of its growth are similar to, or different from, those of its botanical ally—wheat (both belonging to the same natural family, the *Graminaceæ*), is one of very considerable interest, both practical and scientific.

Little less interesting would it be, not only to compare the results obtained with winter-sown wheat and spring-sown barley, but to include in the comparison the likewise spring-sown oats, the third in importance among the corn-yielding plants of the graminaceous family cultivated in temperate climates. But the experiments on the continuous growth of oats have, as yet, only extended over a very few seasons; so that at present we can only incidentally and imperfectly make reference to them. There is, however, already sufficient indication that the results will, in due time, have considerable, both independent and comparative, value.

The first experimental wheat-crop, in the field in which the 30th in succession is now growing, was harvested in 1844; and, in the spring of 1845, about 10 acres, in an immediately adjoining field, were appropriated to somewhat similar experiments on barley. Owing, however, to the great amount of labour and attention that would be required in following them up with sufficient accuracy and detail, it was decided to rest satisfied for a time with the first year's clear indications. These were sufficient to show the great similarity, in some important respects, between the requirements and the conditions of growth of the two closely allied crops. But very much still remained to be learnt, and especially in regard to the equally important distinctions between the requirements of the two crops.

Much also was still wanting in the way of direct experimental evidence bearing upon the then opening "Mineral Theory" controversy; respecting the issues of which very few English agricultural readers are not, by this time, overwhelmingly satisfied. Indeed, the universal practical experience of British agriculture during the last quarter of a century of experiment, discussion, and general improvement, has entirely confirmed the views we have held on the subject, and published in this Journal; whilst our distinguished opponent has not only sought to associate with the term "Mineral Theory," a meaning totally different from that which attached to it in the well-known controversy, but, under cover of a change of nomenclature, has claimed, as consistent with his own theory, views directly at variance with those he formerly maintained, and in the main accordant with the facts and conclusions which we have brought forward in opposition to the distinctive views of his earlier writings. Some illustrations bearing upon these points will be incidentally given further on; but considering how settled are the opinions now generally held on the subject in this country, and how changed are those of the author of the "Mineral Theory," it would be out of place to devote so much of either time or space to its discussion in our introductory remarks as has been suitable on former occasions.

Still less will it be necessary to discuss the results obtained with barley very prominently in their relation to the points that were in controversy in the early years of the progress of the experiments.

The experiments on barley were re-commenced in 1852, and the twentieth crop in succession was harvested in 1871. The land selected was a portion of that immediately adjoining the experimental wheat field, on which the preliminary trials in 1845 had been made. About 4¼ of the 10 acres were devoted to the purpose. The general character of the land is much the same as that of the wheat field, namely, "a somewhat heavy loam, with a subsoil of raw, yellowish red clay, but resting in its turn upon chalk, which provides good natural drainage." The wheat field has, however, as a matter of experiment, been artificially drained, but the barley field has not.

The custom of the locality, in the case of land of similar quality, is to take the barley crop after roots fed off by sheep. But it will be readily understood from the above description of the soil, that it is too heavy for this to be done with advantage in wet seasons. Nevertheless, good crops, both in point of quantity and quality, are so grown, on such land, in favourable seasons, and may, as a rule, be relied upon when barley is taken, not after folding, but after another corn crop.

The questions to be solved by the experiments on barley may be stated in the same terms as were employed in introducing the Report of the results obtained with wheat:—"What are the grain-yielding capabilities of such land?—what its powers of endurance?—in what constituents, or class of constituents, does it soonest show signs of exhaustion?—and how far will the answers arrived at on these points in reference to it, accord with, or be a guide to, those which would apply to any large proportion of the arable land of Great Britain when farmed in the ordinary way, with rotation?"

The Field Experiments on Barley.

The previous cropping of the land set apart in 1852 for the continuous growth of barley was as under:—

1847, Swedish turnips, with farmyard manure and superphosphate (the roots carted off).

1848, Barley.

1849, Clover.

1850, Wheat.

1851, Barley, with sulphate of ammonia.

It had thus already grown two corn crops in succession, and was, therefore, agriculturally speaking, in a somewhat exhausted condition for the after-growth of grain, and would, in the course of ordinary practice, be re-manured before growing another crop. It was, therefore, in a suitable state for testing the effects of different manures upon the crop, and for showing, by the results, in what constituents, or class of constituents, the soil had, by the previous cropping, become practically the most deficient.

The area of 4½ acres was divided into 24 nearly square plots; most of which were exactly one-fifth of an acre each, but the remainder somewhat less. Two plots were left unmanured; one was manured every year with farmyard-manure; and others with different manures, which, respectively, supplied certain constituents of farmyard-manure, separately or in combination.

We here repeat, in answer to objections recently reiterated (this time in Germany), that we believe comparative results obtained by growing crops year after year on the same land, without manure, and with different manurial constituents, singly and in admixture, are far better calculated to indicate in what constituent or constituents the soil is relatively deficient, so far as the available supply for the crop to be grown is concerned, than what is generally understood as an analysis of the soil. On this point it may be well to quote a paragraph from our paper on the growth of Wheat for twenty years in succession on the same land:—

"Our conclusion, as indicated in former papers, and frequently expressed in answer to the objections of chemical friends who had not paid special attention to the applications of chemistry to agriculture, was, that far more had yet to be done in determining the chemical and physical qualities of soils in relation to the atmosphere, and to manurial substances exposed to their action, as well as in perfecting methods of analysis, before comparative analyses could aid us much in deciding upon the relative productiveness of different soils, to say nothing of the still more difficult problem of estimating, by such means, the condition of fertility or exhaustion of one and the same soil at different times. Of late years very much has been done in these departments of investigation; still, as recent discussions abundantly show, far too little is even yet known of what a soil either is or ought to be, in a chemical point of view, to render the results of the analysis of soils directly applicable to the solution of questions such as those we had in view in our inquiry. But if our knowledge of the chemistry of soils should progress as rapidly as it has during the last twenty years, the analysis of a soil will ere long become much more significant than it is at present." ('Journal of the Royal Agricultural Society,' vol. xxv. p. 98.)

In accordance with the views here indicated, we have from time to time, from 1846 up to 1870, taken samples of the soils and subsoils of our different experimental plots, until the collection now comprises about 300 specimens. In a large proportion of these the nitrogen, and in some the carbon, has been determined. Some have been experimented upon at Rothamsted in other ways, and some at Munich by Baron Liebig's son, Hermann von Liebig, who requested to have samples for examination; and the whole are carefully prepared and preserved, with a view to more complete investigation whenever time will permit. Reference will be made further on to some of the results that have been obtained. It is, then, not the chemical examination of soils on a systematic plan, and by methods carefully arranged and well adapted for the solution of specific questions, that we have regarded as unimportant; but it is the mere determination, in accordance with antiquated theoretical ideas, of the ultimate percentage composition of a soil, without due regard to the condition in which the constituents exist, and by methods which do not give sufficiently accurate or comparative results, that we have considered of little value. In the meantime let us see whether the synthetic, as distinguished from the analytic method of enquiry, will not give as important and conclusive evidence as to the conditions and requirements of growth of barley, as it has done in regard to other crops.

General Description of the Manures employed.

It has already been said that the selection of manures for the experiments on barley was, in many respects, the same as that adopted for those on wheat. In reference to this point it may be useful, by way of illustration, to show the probable average amounts of certain constituents in what may be taken as fairly corresponding crops of wheat and barley. For this purpose we will assume a produce per acre of—

Wheat, 30 bushels, of 60 lbs. per bushel = 1800 lbs., and 3000 lbs. straw, = 4800 lbs. total produce;

Barley, 40 bushels, of 52 lbs. per bushel = 2080 lbs., and 2500 lbs. straw, = 4580 lbs. total produce;

which will contain, approximately, the following constituents:—

	In Corn.		In Straw.		In Total Produce.	
	Wheat.	Barley.	Wheat.	Barley.	Wheat.	Barley.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Nitrogen	32	33	13	12	45	45
Phosphoric acid ..	16	17	7	5	23	22
Potass	9·5	11·5	20·5	18·5	30	30
Lime	1	1·5	9	10·5	10	12
Magnesia	3·5	4	3	2·5	6·5	6·5
Silica	0·5	12	99·5	63	100	75

It will be observed that most of the above constituents (which, in the sense that they are those which are the most likely to become deficient in the soil, may be said to be the most important constituents of the two crops) occur in nearly equal amounts in the total produce of either. The most prominent exceptions are, that the total barley crop would remove rather more lime, but considerably less silica, than the wheat crop. But looking to the grain alone, the barley is seen to remove considerably more of silica, and rather more of each other constituent, than the wheat. Therefore, in cases in which the grain only is sold, and the straw is returned to the land in due course as manure, the eventual loss to the soil would be upon the whole greater, especially in silica, by the growth of such a crop of barley than of such a crop of wheat. In the experiments now to be considered, however, both corn and straw are always entirely removed from the land.

In Germany, it has recently been urged against the plan of our experiments, that the amounts of the different constituents applied as manure, for the different crops, have no direct relation to the amounts which are annually removed from the soil in the crops. We freely admit that this is the case. We at the same time maintain that, with the existing knowledge at the time of the arrangement of the experiments—nay, even with present knowledge, or rather ignorance—of the reactions of the different manurial substances within the soil, of the consequent distribution and state of combination within it of the constituents they supply, and of how far, accordingly, they are available for the crop to be grown, it would be the merest pedantry to apply only so much of each constituent as had been, or was expected to be, removed in the crop. We have, indeed, followed the plan supposed by our critics, in isolated cases, with the view of testing the validity of the assumptions upon which it is founded, and the result has been most signal failure, so far as the amount of the resulting crop is concerned.

Both the description, and the amounts, of the manures actually employed for the barley, are recorded in full in the folding Table, No. XXIV., and in Appendix—Table I., p. 163. They are in many respects the same as were adopted in the wheat experiments; and, as in those experiments, the most available and convenient forms in which the different constituents occur in the market have been selected. Thus (omitting from the enumeration those supplied in farmyard manure and rape-cake), the different "mineral"* or ash-constituents were supplied as follows:—

* With regard to the use of the term "mineral" see vol. xxiv., pp. 506-8 (foot-note), and vol. xxv., p. 101 (and context), of this Journal; also vol. xvi. pp. 447-8, and context.

Potass—as sulphate of potass.
Soda—as sulphate of soda.
Magnesia—as sulphate of magnesia.
Lime—as sulphate, phosphate, and superphosphate.
Phosphoric acid—as bone-ash, mixed with sulphuric acid in quantity sufficient to convert most of the insoluble earthy phosphate of lime into sulphate and soluble superphosphate of lime.
Sulphuric acid—in the phosphatic mixture just mentioned; in sulphates of potass, soda, and magnesia; in sulphate of ammonia, &c.
Chlorine—in muriate of ammonia.
Silica—as artificial silicate of soda.

Other constituents have been supplied as under:—

Nitrogen—as sulphate and muriate of ammonia; as nitrate of soda; in farmyard manure; in rape-cake.
Non-nitrogenous organic matter, yielding by decomposition carbonic acid, and other products—in farmyard manure, in rape-cake.

The artificial manure or mixture for each plot is ground up, or otherwise mixed, with a sufficient quantity of soil and turf-ashes to make it up to a convenient measure for equal distribution over the land. The mixtures so prepared are, with proper precautions, sown broadcast by hand; as it has been found that the application of an exact amount of manure, to a limited area of land, can be best accomplished in that way.

The Field Results.

The results obtained with barley will be arranged and discussed under separate heads, adopting much the same division of the subject as in the report on the experiments with wheat, but following a somewhat different order of illustration. Accordingly, they will be considered in Sections as under:—

I.—Quantity and quality of the produce obtained, by different descriptions of manure, in each of the twenty seasons; with summary statements of the characters of each season.

II.—Average annual produce obtained over many years in succession, by each description of manure employed.

III.—Amount of ammonia in manure (or its equivalent of nitrogen in other forms), required to yield a given increase of grain (and its proportion of straw), according to the quantity applied per acre, to the available supply of mineral constituents within the soil, and to the characters of the season.

IV.—Effects of the unexhausted residue from previous manuring (*both nitrogenous and mineral*) upon succeeding crops, loss of constituents by drainage, and some allied points.

V.—Comparison of the results with those obtained in other fields, and under other conditions as to cropping, manuring, &c.

VI.—Summary, and general conclusions, showing the practical bearings of the results.

On this plan, the consideration in Section I. of the fluctuations in the quantity and quality of the produce due to season, and in Section II. of the average results obtained by the different manures over many seasons, will bring before the reader the main facts of the field experiments as such. He will then be in a position to appreciate the great practical importance, and the great scientific interest, of the questions discussed in Sections III. and IV., and to judge of the value of the evidence brought to bear upon them.

Section I. Quantity and quality of the Produce obtained in the different Seasons.

In the following comments on the quantity and quality of the produce obtained in each of the twenty seasons separately, the observations on the characters of the seasons themselves are founded, partly on Mr. Glaisher's quarterly reports, partly on our own, and partly on other records; and they, as well as those relating to the crops of the country, may be taken as in the main applicable, so far as such brief and general statements can be, to a considerable portion of the Midland, Eastern, and South-Eastern districts of England. It may be further explained that, to aid the study of the characters of the several seasons, and with a view to the statements given of them, Tables have been arranged showing the actual climatic statistics of the seasons, and also others of their indices, showing the relative order of the characters registered, comparing season with season.

A little consideration will show that this branch of the subject is not less intricate than it is important; and it can of necessity be but incidentally and incompletely treated of within the limits of such a paper as this. Thus, it is obvious that different seasons will differ almost infinitely at each succeeding period of their advance, and that, with each variation, the character of development of the plant will also vary, tending to luxuriance, or to maturation, that is, to quantity, or to quality, as the case may be. Hence, only a very detailed consideration of climatic statistics, taken together with careful periodic observations in the field, can afford a really clear perception of the connection between the ever fluctuating characters of season and the equally fluctuating characters of growth and produce. It is, in fact, the distribution of the various elements making up the season, their mutual adaptations, and their adaptation to the stage of growth of the plant, which throughout influence the tendency to produce quantity or quality. It not unfrequently happens, too, that some passing conditions, not indicated by a summary of the meteorological registry, may affect the crop very strikingly; and thus the cause will be overlooked, unless careful observations be also made, and the stage of progress, and tendencies of growth, of the crop itself at the time, be likewise taken into account.

Having regard to these considerations, and to the well-known fact—which is only their practical consequence—that those characters of season which are very unfavourable for land in poor condition, may be favourable to land in high condition, and *vice versâ*, such a selection from the results obtained in each year has been made as it was thought would best illustrate the influence of season on the productive effects of characteristically different conditions of manuring; and for each of the twenty seasons the produce of the same plots is taken for illustration.

In explanation of the abbreviated descriptions of the manures given in the Tables, it may be stated that—

The "farmyard manure" was made in the open yard, and did not contain the dung of animals highly fed on purchased food.

The "Mixed Mineral Manure" was composed, per acre per annum, of—

200 lbs. sulphate of potass (300 lbs. the first 6 years).
100 lbs. sulphate of soda (200 lbs. the first 6 years).
100 lbs. sulphate of magnesia.
200 lbs. bone-ash. } superphosphate of
150 lbs. sulphuric acid, sp. gr. 1·7 } lime.

The "Ammonia Salts" consist of an equal mixture of the sulphate and muriate of ammonia of commerce.

For the sake of easy reference, and for comparison with the produce in each individual season, there is given in Table I., on the following page, the particulars of the average produce over the 20 years, on each of the plots selected for illustration in this Section.

In passing, the significant fact may here be noted, that, over a period of 20 years in succession, ammonia-salts alone gave an average, per acre per annum, of 5 bushels more corn, and of 4 cwts. more straw, than the mixed mineral manure alone. Again, the ammonia-salts and mixed mineral manure together gave an average annual produce of about 19 bushels more corn, and 14 cwts. more straw, than the mineral manure

TABLE I.—Average Quantity and Quality of Barley per Acre, per annum, on selected plots. Twenty Years, 1852–1871.

Plots.	MANURES, PER ACRE, PER ANNUM.	AVERAGE PRODUCE, &c., PER ACRE PER ANNUM.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bushel.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
1 O	Unmanured	20	52·3	1133	11¾	2454	86·6
7	14 Tons Farmyard Manure	48¼	54·3	2768	28¼	5933	88·5
4 O	Mixed Mineral Manure, alone ..	27½	53·4	1550	14⅜	3162	96·4
1 A	200 lbs. Ammonia-salts, alone ..	32½	52·1	1840	18½	3919	89·2
4 A	Mixed Mineral Manure, and .. 200 lbs. Ammonia-salts	46¼	54·0	2630	28½	5817	83·2
4 AA	Mixed Mineral Manure, and .. .. 400 lbs. Ammonia-salts first 6 years 200 lbs. Ammonia-salts next 10 years 275 lbs. Nitrate Soda last 4 years ..	49¾	53·4	2813	32⅜	6443	79·5
4 C	Mixed Mineral Manure, and .. .. 2000 lbs. Rape-cake first 6 years 1000 lbs. Rape-cake last 14 years ..	47⅞	53·6	2698	29½	6002	83·0

alone; but only about 14 bushels more corn, and 10 cwts. more straw, than the ammonia-salts alone.

There can be no doubt, therefore, that in this, in an agricultural sense, already corn-exhausted soil, the available supply of nitrogen was much more readily exhausted than the available supply of mineral constituents, so far as the requirements for the growth of barley are concerned.

It may be stated at the outset then, that the results obtained with barley, so far show general accordance with those on wheat; and that those with both crops are entirely inconsistent with the "Mineral Theory," according to which it was maintained—"that the supply of ammonia is unnecessary for most of our cultivated plants, and that it may be even superfluous, if only the soil contain a sufficient supply of the mineral food of plants, when the ammonia required for their development will be furnished by the atmosphere."

We need hardly say that the sharp distinction, the direct antithesis, between the terms "mineral" and "ammonia," as used in the above sentence, was habitually adopted by Baron Liebig in his earlier agricultural writings*; in fact, the "Mineral Theory" which was so long in controversy, can hardly be more clearly stated in so few words, than in those just given, written by himself.

* For a few additional illustrations see foot-note pp. 506-8, vol. xxiv. part 2 of this Journal.

Notwithstanding this, what does he say now? He ignores his former arguments and views. He repudiates the obvious meaning of the terms he employed. He attributes to his opponents ignorance of the fact that, in a special scientific sense, ammonia-salts are mineral substances. He says—"All the materials constituting the food of our cultivated plants belong to the mineral kingdom." And—"Sulphate of ammonia and salammoniac are mineral . . . ." Thus, ammonia is now claimed as a mineral manure, instead of antithetic to it, as throughout his earlier writings; and, accordingly, he claims as consistent with his "Mineral Theory," any beneficial effects from the use of nitrogenous manures. He would, indeed, have it supposed by the rising generation of readers, and if possible established for the future, that the "Mineral Theory" of Agriculture which has been in controversy is the "Mineral Theory" of vegetation in general, according to which, as distinguished from the so-called "Humus Theory," all the food of plants is mineral.

Having made these fundamental changes, without acknowledgment of either change or error, he endeavours to divert the attention of his modern and future readers from his earlier works and editions, and insinuates that the error has been on the side of his opponents. Thus, in 1870, in the course of a disquisition on the claims of *truth* in scientific inquiry, he speaks of his long forbearance in reference to the opposition to his views on the theory of fermentation, the sources of muscular power, the formation of fat, &c., and, in agricultural chemistry, on the laws of the nutrition of plants and animals. But, he goes on to say, there is for every one a limit, when it becomes his duty again to contend for that which he holds to be true, and this is reached, when error has gained the victory, and scarcely a doubt is expressed that it may be the truth. Then, with more special reference to the controversy with ourselves, he proceeds—

"In this way it happened to my views on agriculture, on the causes of the exhaustion of soils, and the conditions of the restoration of their fertility; in the 16 years which elapsed between the sixth and seventh editions of my book, my doctrine was as good as buried, by the majority of practical agriculturists it was held to be completely refuted, which might well be quite unhesitatingly assumed, since one of the most renowned Scientific Societies had bestowed its great gold medal upon my most persevering opponents, as a seal of their triumph over the mineral theory. With the publication of the seventh edition of my 'Chemistry in its applications to Agriculture and Physiology,' a refutation of my doctrine is no longer spoken of, and the younger generation of farmers, standing in a far higher scientific position, no longer comprehend how there was so much disputing and quarrelling over truths which now seem to them self-evident."*

Considering that the "Mineral Theory," about which there was so much "disputing and quarrelling" has in reality been so long both refuted and buried, and that its author not only seeks to repudiate it, but to adopt without acknowledgment the views of his opponents put forward in correction of his own, it would be only waste of the reader's time to repeat the process of refutation and burial in any detail here. But those who may be curious to examine into the history and the truth of the matter for themselves, we would refer to the third and fourth English editions of Baron Liebig's book (1843 and 1847), or to the German editions *prior to the seventh*, and to our own papers in Volumes xii., xvi., xxiv., and xxv. of this Journal.

Before commencing the consideration of the individual seasons, it may be well to add, by way of preliminary statement, that in the comments on the varying quantity and quality of produce obtained by one and the same manure according to season, the comparisons of the produce of each separate season with the average of the twenty seasons, will be made with as little reference as may be needed to the question of how far the result may be affected by the use of the same manure year after year on the same plot. In accordance with the plan already given, this subject, of the degree, or the limit, of the effects of accumulation, or of exhaustion, by previous manuring and cropping, on the produce of succeeding seasons, will receive separate and full consideration in Section IV.

Lastly, it will be useful to bear in mind throughout, that, so far as the influence of *season* is concerned, the *quantity* of the produce depends greatly on the amount and the distribution of rain during the growing period; and the *quality* (proportion of corn and quality of corn), on a suitable adaptation of temperature. And, so far as the influence of *manures* is concerned, the

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* The following is the paragraph from the original—

"In dieser Weise war es meinen Ansichten über den Feldbaubetrieb, über die Ursachen der Erschöpfung der Felder und die Bedingungen der Wiederherstellung ihrer Fruchtbarkeit ergangen; in den 16 Jahren, die zwischen der 6. und 7. Auflage meines Buches liegen, war meine Lehre so gut wie zu Grabe getragen, sie wurde von der grossen Mehrzahl der practischen Landwirthe für vollkommen widerlegt gehalten, was wohl ganz unzweifelhaft daraus entnommen werden dürfte, dass eine der berühmtesten wissenschaftlichen Gesellschaften ihre grosse goldene Medaille meinen beharrlichsten Gegnern zur Besiegelung ihres Triumphes über die Mineraltheorie verliehen hat. Mit der Veröffentlichung der 7. Auflage meiner 'Chemie in ihrer Anwendung auf Agricultur und Physiologie,' ist von einer Widerlegung meiner Lehre nicht mehr die Rede, und die jüngere, wissenschaftlich weit höher stehende Generation der Landwirthe begreift es nicht mehr, dass so viel Hader und Zank über Wahrheiten war, die ihnen jetzt als selbstverständlich gelten." (Ueber Gährung, über Quelle der Muskelkraft und Ernährung. Vorrede, pp. ix-x.)

quantity (luxuriance) depends greatly on the available supply of nitrogen within the soil, and the *quality* of the crop (tendency to form seed and to ripen), on the available supply of mineral or ash-constituents.

First Season, 1852.

November and December, 1851, were upon the whole fine, but colder than usual. January and February, 1852, were mild and wet; March dry and clear, but cold and frosty; April dry, with some hot sun, but a good deal of cold east wind; May variable, but also with a good deal of cold east wind; June very wet and cold; July very hot, with several heavy thunderstorms; August fine at the beginning, very wet in the middle, and fine and hot at the end; September fine until the 6th, when there was a heavy thunderstorm, with a good deal of rain, the rest of the month being variable, with prevailing low temperatures, but upon the whole not unfavourable. In June the dew point was below, but the degree of humidity of the air slightly above the average; in July the dew point was above, but the degree of humidity considerably below the average; and in August and September both dew point and the degree of humidity were below the average.

Thus, the early portions of the winter were, upon the whole, fine but cold; but the later for the most part mild and wet. Then followed drier weather, allowing of an early working of the land. The spring was, however, dry, cold, and backward; the early summer rainy and cold, and the maturing period variable, with a good deal of hot weather, and some heavy storms.

The winter-sown wheat crop was reported to be generally not deficient in bulk, but in many districts much blighted, mildewed, and grown; the result being a yield considerably below the average. Shortly before harvest, barley as well as wheat was reported to be a bulky crop, and to give upon the whole a fair promise, though the hot weather of July was tending to premature ripening, especially on the lighter lands; and the very variable weather of the maturing period greatly lessened the yield, and injured the sample.

The experimental wheat crop was much below the average in quantity of both corn and straw, and also considerably below the average in quality of grain. Table II. (p. 102) exhibits the results obtained on the selected plots in the experimental barley field.

The weather was favourable for the preparation of the land, and the seed (Chevalier) was sown on March 5. The quantity of produce, both corn and straw, was, without manure, by mineral manure alone, and by ammonia-salts alone, considerably greater in this first season than on the average of the 20 years under the same continued conditions as to manure. The comparatively

TABLE II.—Quantity and Quality of Barley on Selected Plots. First Season, 1852.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bushel.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	33	52·8	1844	18½	3920	88·8
1 O	Unmanured	27¼	52·1	1585	16⅝	3445	85·2
4 O	Mixed Mineral Manure ..	32¾	51·5	1819	19½	4008	83·1
1 A	200 lbs. Ammonia-salts ..	36⅞	50·7	2088	22⅞	4652	81·5
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	40¾	51·4	2368	27⅞	5487	75·9
4 A A	Mixed Mineral Manure, and 400 lbs. Ammonia-salts ..	45⅛	50·6	2532	28⅜	5714	79·6
4 C	Mixed Mineral Manure, and 2000 lbs. Rape-cake ..	38	51·4	2098	24⅛	4796	77·7

large produce without manure, and by mineral manure alone, in the first year, shows that there was a quantity of unexhausted nitrogen from previous manuring available within the soil. The larger produce by ammonia-salts alone in the first than over the 20 seasons shows, in like manner, a comparative exhaustion of available mineral constituents in the later years. On the other hand, in the case of the farmyard manure, and the artificial manures in which there was annually supplied an abundance of mineral constituents as well as ammonia, or nitrogen in some form, the average produce of the 20 years considerably exceeded that of the first year. Part of this latter result is doubtless due to accumulation from year to year; but no doubt it is also in great measure due to the comparatively defective productive characters of the first season. This conclusion is confirmed by the fact that, the quality of the produce, as indicated by the weight per bushel, was, both from the deficiently and from the liberally manured plots, considerably below the average. The proportion of corn to straw was also in most cases below the average.

The results obtained in the experimental field are accordant, therefore, with those over a considerable area of the country, in showing that the variable, but upon the whole wet and cold season of 1852, was unfavourable to the barley crop, and especially so in point of quality.

Second Season, 1853.

Up to the middle of January, the winter of 1852-3 was, upon the whole, very unseasonably warm and wet; the rest of January, February, and March, were very cold, with a good deal of east and north-east wind, and some snow; April and May were for the most part cold and wet, with the exception of a short period in the middle of each month; June was variable, with a good deal of rain and cold wind; the greater part of July was excessively wet, with low temperatures, but the end of the month, and the beginning of August, were fine; the remainder of August, and September, were dull, unsettled, wet, and cold. Both the dew point and the degree of humidity of the air were generally, and, especially the latter, sometimes considerably below the average in June, July, August, and September.

Thus the autumn and early winter were exceedingly wet; so much so, indeed, that a considerable breadth of the land intended for wheat could not be sown. The remainder of the winter, and the spring, were for the most part unseasonably cold, or cold and wet; so also were the summer, and the harvest time, with the exception of a short period at the end of July and the beginning of August.

The wheat crop was reported to cover a very limited area, and to be far inferior to that of any season for many years past. Barley and oats were, however, sown over an unusually large area, and neither crop was reported to have suffered anything like so much as wheat.

The experimental wheat was not sown until the spring, and its crop was one of the worst that has been obtained up to the present time. The experimental barley was not sown until April 11; and the following are the results obtained on the selected plots:—

TABLE III.—Quantity and Quality of Barley on Selected Plots. Second Season, 1853.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bushel.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	$36\frac{1}{8}$	51·6	2136	$22\frac{3}{4}$	4682	83·9
1 O	Unmanured	$25\frac{3}{4}$	51·4	1552	18	3562	77·2
4 O	Mixed Mineral Manure ..	$35\frac{5}{8}$	52·1	2017	$20\frac{1}{2}$	4312	87·9
1 A	200 lbs. Ammonia-salts ..	$38\frac{5}{8}$	52·4	2285	$23\frac{3}{4}$	4950	85·7
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	$38\frac{1}{4}$	53·1	2309	$26\frac{5}{8}$	5284	77·6
4 A A	Mixed Mineral Manure, and 400 lbs. Ammonia-salts ..	$44\frac{1}{2}$	51·4	2590	$31\frac{5}{8}$	6134	73·1
4 C	Mixed Mineral Manure, and 2000 lbs. Rape-cake	$40\frac{1}{8}$	50·4	2302	$27\frac{1}{2}$	5386	74·6

Under the influence of this unusually cold and wet season, the weight of total produce (corn and straw together) was, without manure, and with the partial manures, that is, with mixed mineral manure alone, or ammonia-salts alone, rather more than in the first season, and very considerably more than the average of the 20 seasons. With farmyard manure it was considerably more than in the first season, but considerably less than the average. With the more complete artificial manures, supplying mineral constituents in abundance as well as ammonia, there was a considerable deficiency compared with the average; and more in the corn than in the straw. This comparatively worse result in the cold and wet season with the more liberal, than with the more partial manuring, is in great measure to be explained by the fact, that all the heavier crops were very much more laid than the lighter ones. Accordingly, the weight per bushel of dressed corn, which was in almost every case considerably lower than the average, was, so far as the artificial manures were concerned, the lower the higher the proportion of nitrogen to the mineral constituents in the manure; that is to say, the more the tendency to luxuriance, or quantity of gross produce, prevailed over that of seed-forming and ripening.

The results as a whole are an illustration of that which common experience teaches, namely, that with a cold and wet season the naturally light and poor, and the poorly manured lands, suffer much less than the naturally better, or more liberally manured soils. Another point of general interest is, that spring-sown corn as a rule suffers much less in such a season than the winter-sown wheat. Indeed, an amount of spring and summer rain which may be essential for the luxuriant growth, and subsequent yield, of the late-sown barley or oat crop, will frequently be adverse to the yield of the winter-sown wheat crop.

Third Season, 1854.

The winter of 1853-4 was, until past the middle of February, upon the whole unusually severe, with a good deal of snow; March and the greater part of April were very fine, but at the end of the latter month there was severe frost for the period, and a good deal of cold north wind; May was variable, generally cold and backward, with a good deal of rain; June was generally fine, but cold; the first half of July was also cold, with a moderate amount of rain; then came a week or two of fine hot weather, which was succeeded by thunderstorms and heavy rain; the beginning of August was wet, the middle fine though not warm, but the end dry and hot; September was almost throughout fine and favourable for getting in the crops, with high day, though low night, temperatures. In June, July, August, and September, the dew point was below the average, and the degree of humdity of the air was, in June above, in July about, and in August and September below, the average.

The autumn seed-time had been very favourable; it was followed by an unusually severe winter, but the spring seed-time was not unfavourable. This was succeeded by generally fine but generally cold and backward weather, until the middle of July, from which time, however, until harvest, the period, though changeable, embraced some fine maturing and harvest weather.

The season of 1854 appears, therefore, by the climatic records, to have been by no means continuously favourable, and the harvest was late; yet the wheat-crop of the country was reported to be one of the largest yield per acre for many years past. The barley and oat crops were also spoken of as generally very good.

The experimental wheat-crop was as remarkable for superiority in almost every particular, both of quantity and quality, as that of 1853 had been in the opposite direction. The following results were obtained in the experimental barley field:—

Table IV.—Quantity and Quality of Barley on Selected Plots. Third Season, 1854.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bushel.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	56⅜	53·9	3127	37¼	7298	75·0
1 O	Unmanured	35	53·6	1963	21¾	4405	80·4
4 O	Mixed Mineral Manure ..	42	54·0	2374	23⅛	4969	91·5
1 A	200 lbs. Ammonia-salts ..	47¾	53·6	2763	30¼	6155	81·5
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	60⅝	54·3	3428	40½	7958	75·7
4 A A	Mixed Mineral Manure, and 400 lbs. Ammonia-salts ..	62¾	52·1	3539	49	9026	64·5
4 C	Mixed Mineral Manure, and 2000 lbs. Rape-cake ..	60¼	52·8	3413	42⅛	8125	72·4

The seed was sown as early as February 24th; and the season, though backward, was without material checks. The result, with the early start, and these conditions, was a great bulk of produce, which, for its amount, was comparatively little laid; and, with favourable harvest weather, it finally yielded a large amount of corn as well as straw, and generally a good weight per bushel. Under every condition of manuring the produce was considerably higher than in either of the two preceding seasons, and considerably higher also than the average of the 20 seasons. It was, in fact, under most of the conditions of manuring, in straw higher, and in corn also higher than, or nearly as high as, in any of the 20 years. In 3 of the selected cases the produce exceeded 60 bushels of dressed corn, and 2 tons of straw, per acre. The season of 1854 was, therefore, one of remarkable productiveness; and it was remarkable for yielding such large crops under climatal conditions which the mere meteorological registry did not indicate to be peculiarly favourable. The result would appear to have been owing, as in the also remarkable season of 1863, to a continuity of unchecked growth, rather than to any special aptitude for unusual luxuriance at particular periods. Lastly, although the quantity of grain per acre was very large, the proportion of corn to straw was considerably below the average. It is probable, indeed, that the great yield was due to favourable conditions of season at the time of seed-forming, acting upon a great bulk of plant, and not to conditions favourable to seeding tendency through any lengthened period of growth.

Fourth Season, 1855.

The winter of 1854-55 was generally fine and mild up to the middle of January. Then came some frosts and deep snow; and the frost, with occasional snow, rain, and thaw, lasted, with more or less severity, through February and March. The beginning and end of April were also cold and frosty, and the month was more or less windy throughout, with dry east winds at the close. May and June were for the most part very cold and dry, with the exception of a short interval in the middle of that period, and the end of June, which was very hot; July was very variable, with many fine hot days, but with severe thunderstorms, and, upon the whole, a great excess of rain. The beginning of August was also wet, but the remainder of the month was fine; September also was fine, but cool. In June, August, and September, both the dew point and the degree of humidity of the atmosphere ranged low, but in July both were somewhat in excess of the average.

Thus, the latter part of the winter, and the early spring, were extremely severe; the remainder of the spring and the early summer cold and dry; July was very variable, with a great deal of rain, and a rather humid atmosphere; but the harvest period was more favourable.

With these characters of season, the wheat crop of 1855 was reported to be much less abundant than that of 1854; in quantity about, or but little over, an average—in quality very various, and in many cases much damaged. Barley was reported to be abundant, but damaged, yielding a bad malting sample.

In the experimental wheat field, the season of 1855 was one of average productiveness with moderate manuring, but was unfavourable for high manuring, that is for the growth and maturing of large crops. The selected plots in the experimental barley field gave the following results :—

TABLE V.—Quantity and Quality of Barley on Selected Plots. Fourth Season, 1855.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bushel.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	$50\frac{1}{8}$	52·9	2765	$27\frac{1}{2}$	5852	89·6
1 O	Unmanured	31	52·4	1773	$17\frac{5}{8}$	3745	89·9
4 O	Mixed Mineral Manure ..	$37\frac{1}{8}$	53·1	2067	18	4082	102·6
1 A	200 lbs. Ammonia-salts ..	$44\frac{1}{2}$	51·8	2443	$24\frac{1}{8}$	5148	90·3
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	$48\frac{3}{8}$	52·0	2659	31	6134	76·5
4 A A	Mixed Mineral Manure, and 400 lbs. Ammonia-salts ..	$49\frac{5}{8}$	48·9	2582	$39\frac{7}{8}$	7054	57·7
4 C	Mixed Mineral Manure, and 2000 lbs. Rape-cake ..	$51\frac{3}{4}$	49·5	2783	$37\frac{5}{8}$	6993	66·1

A wet and warm July, and the beginning of August also wet, following upon a cold and dry spring and early summer, and, therefore, acting upon a backward crop, ensured a considerable bulk of produce; and with comparatively favourable conditions immediately before harvest, the quantity of corn per acre, as well as that of straw, was also above the average of the 20 years; excepting in some of the cases of the heavier crops, which were much laid. The corn-yielding characters of the crop varied, however, very considerably; the proportion of corn to straw, and the weight per bushel of the dressed corn, being generally considerably the lower, the greater the proportion of nitrogen to mineral constituents in the manure; that is to say, the more the manures supplied the conditions favourable to luxuriance and bulk, rather than to seeding tendency. Thus, by mineral manures alone, there are only $37\frac{1}{8}$ bushels of corn, and 18 cwts. of straw, but 102 parts of corn for 100 of straw, and more than 53 lbs. weight per bushel; whilst with the same mineral manure and 400 lbs. ammonia-salts per acre, there are nearly 50 bushels of corn, and nearly 40 cwts. of straw, but less than 58 parts of corn to 100 of straw, and less than 49 lbs. per bushel. The very varied conditions of manuring supplied in the experimental field have, therefore, furnished, in their results, a striking illustration of how differently the same conditions of season may affect the produce of light and of heavy, or of deficiently or highly manured land; and how an excess of rain during the actively growing period may be beneficial under bad, and injurious under good agricultural conditions.

Fifth Season, 1856.

After a wet autumn, and some severe weather in the early part of the winter, January 1856 was very variable, but, upon the whole, mild, as was also February; March was dry and cold, with piercing north-east winds; April and May generally cold, and May particularly, very wet; June and July changeable as to temperature, with little rain, and frequently very cold nights until nearly the end of the latter month, which, with the beginning of August, was fine and hot; then came heavy thunderstorms with excessive rain, but the end of August, and the first half of September, were fine, after which again succeeded thunderstorms and heavy rain, the temperature being generally low throughout the month. The mean dew point, and degree of humidity of the air, were above, or about, the average in June, July, and August, and somewhat below it in September.

Thus, after a variable, but upon the whole, mild winter, the early spring was dry and cold, the remainder cold and wet, and the early summer cold and changeable, with little rain; then came a short interval of fine and hot weather, succeeded about the ripening period by very heavy rains and prevailing low temperatures. The harvest period was much broken, generally wet and unfavourable, especially in the later districts.

Wheat was reported to cover a large area; and shortly before harvest it was thought the crop would be over an average. Barley and oats were also expected to be over average per acre; though barley was said to cover an unusually small area. Eventually, however, owing to the unfavourable harvest-weather, and the deficiency of labour, a considerable proportion of all three crops was much damaged and badly got in.

The experimental wheat crop was, with liberal manuring, in quantity of straw over, and in that of grain fully equal to, the average; but it was unevenly and badly ripened, and the weight per bushel was low.

The results exhibited in Table VI. (p. 109) were obtained in the experimental barley field.

The barley was sown on March 8th; and with, for the most part, alternately cold and dry, and cold and wet, spring and summer, the amount of total produce was, under all conditions of manuring, very considerably below the average of the 20 years. The deficiency in quantity of corn was very great, and that of straw also great; though the less the higher the artificial manuring. With the farmyard manure, however, the deficiency

TABLE VI.—Quantity and Quality of Barley on Selected Plots. Fifth Season, 1856.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bushel.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	$32\frac{1}{8}$	47·1	1656	$19\frac{3}{4}$	3866	74·9
1 O	Unmanured	$13\frac{7}{8}$	49·1	812	$8\frac{3}{4}$	1797	82·4
4 O	Mixed Mineral Manure ..	$19\frac{3}{4}$	47·0	1018	$9\frac{3}{8}$	2075	96·3
1 A	200 lbs. Ammonia-salts ..	25	48·5	1432	$17\frac{1}{8}$	3347	74·8
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	$31\frac{3}{4}$	46·4	1599	$21\frac{1}{4}$	3981	67·1
4 A A	Mixed Mineral Manure, and 400 lbs. Ammonia-salts ..	$37\frac{5}{8}$	45·4	1886	33	5582	51·0
4 C	Mixed Mineral Manure, and 2000 lbs. Rape-cake ..	$35\frac{3}{8}$	46·3	1841	$30\frac{1}{2}$	5257	53·9

of straw was proportionally as great as in other cases of low produce. The quantity of corn was, indeed, under many of the conditions of manuring, the lowest, and under all nearly as low, as in any year of the 20; and, with a wet harvest time following upon an almost continuously unfavourable growing period, the proportion of corn to straw was unusually low, especially under the high manuring. The weight per bushel of dressed corn was also very much below the average, and almost throughout lower than in any other of the 20 seasons.

In former seasons it had been observed that, wherever phosphatic manures were used, the crop ripened much earlier than where they were not employed; but hitherto it had been thought desirable to cut all at the same time. From this time forward, however, there have generally been at least two cuttings, with an interval of from a week to a fortnight between them. In the case of the season under consideration, all the lots with phosphatic manure were cut on August 13th, after which there was a week of almost incessant rain, which much damaged both grain and straw, the former being much sprouted. The remainder of the plots were cut on August 29th, and being then dead ripe, were carted on the same day.

Judging from the reports, it would appear that the barley crop of the country generally was not so deficient in bulk as the results show that in the experimental field to have been; but it was probably in many cases equally damaged, and bad in yield.

Sixth Season, 1857.

The last quarter of 1856 was marked by rapid variations of pressure, and extreme changes of temperature. In January

(1857), there was a good deal of rain, and the greater part of the month was mild; but it became colder, with frost and snow, at the end of the month and the beginning of February. The remainder of February, and March, were very dry, with high barometer, frequent sharp frosty nights, and cold easterly winds. April was more rainy, but included also some fine though cold weather. May was fine, with a good deal of very warm weather, and but little rain. In June, again, there was a good deal of fine and hot weather; but there were also several thunderstorms, with heavy falls of rain, which were much needed, and thoroughly penetrated the soil. During July the weather was generally fine, and occasionally very hot, with much less than the usual amount of rain. In August there were several thunderstorms with heavy rain, but otherwise the weather was fine and remarkably hot. In the early part of September a great deal of rain fell, but the remainder of the month was fine, and its temperature was pretty uniformly rather above the average. In June, July, and August, though the dew point ranged somewhat high, the temperature did so in a greater degree, so that the atmosphere was drier than usual.

Thus, after a variable preliminary period, the beginning of the year was mild and wet; in the spring there was, upon the whole, a good deal of cold dry weather, but there was a sufficiency of rain in April. The summer was for the most part hot, with a dry atmosphere, but with genial and plentiful rains in June, and again in the beginning of August. Finally, the harvest period, though somewhat broken, was generally favourable.

The extent of land under wheat was reported to be less than in 1856; but with a summer hotter and drier than usual, though with occasional plentiful rains when most needed, the crop throughout promised exceedingly well; and, after harvest, it was estimated to have been unusually productive. Barley was said to cover a large area, but to be generally deficient in yield per acre, though proportionally less so in the best corn-growing districts of the country. Oats were pronounced to be decidedly below their average productiveness.

The experimental wheat crop, though by no means so bulky as many, was one of very much more than the average yield of grain per acre.

The results obtained with barley are shown in Table VII. (p. 111).

The seed was sown on March 6th. On all the plots having superphosphate in the manure, the crops were ripe earlier than on the others, and were cut on August 3rd, the rest being left till August 10th. In April there was a sufficiency of rain to

TABLE VII.—Quantity and Quality of Barley on Selected Plots. Sixth Season, 1857.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bushel.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	$51\frac{1}{4}$	54·2	2915	$23\frac{5}{8}$	5564	110·0
1 O	Unmanured	$26\frac{1}{8}$	52·0	1453	$12\frac{3}{4}$	2878	102·0
4 O	Mixed Mineral Manure ..	$39\frac{3}{4}$	53·7	2191	$17\frac{1}{8}$	4111	114·1
1 A	200 lbs. Ammonia-salts ..	$38\frac{7}{8}$	51·9	2133	$17\frac{3}{4}$	4118	107·5
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	$57\frac{3}{8}$	54·8	3216	$27\frac{7}{8}$	6336	103·1
4 A A	Mixed Mineral Manure, and 400 lbs. Ammonia-salts ..	$64\frac{7}{8}$	53·9	3677	$36\frac{1}{4}$	7734	90·6
4 C	Mixed Mineral Manure, and 2000 lbs. Rape-cake ..	$62\frac{1}{4}$	54·1	3536	$33\frac{1}{8}$	7241	95·4

establish growth; the summer was almost throughout hot and dry, excepting that there were some heavy falls of rain in June, and again in August; and the result was a crop of more than average bulk, and of very unusual seeding tendency. In fact, there was a higher proportion of corn to straw, and higher weight per bushel of corn, than in any other year of equal gross produce per acre. The season was remarkably favourable for high manuring; and even the heaviest crops, which were very heavy, especially in the ear, were very little laid. Thus, there were, with mineral manure and 400 lbs. of ammonia-salts per acre, $90\frac{1}{2}$ parts of corn for 100 of straw, nearly 65 bushels of dressed corn per acre, and 53·9 lbs. weight per bushel. Again, with mineral manure and 2000 lbs. rape-cake, there were $95\frac{1}{2}$ corn to 100 of straw, $62\frac{1}{4}$ bushels of dressed corn per acre, and a weight per bushel of 54·1 lbs.

The contrast between this season and its produce, and those of 1854, which was also a year of very unusual productiveness, is very great. Throughout the most active growing periods the temperature was very much lower in 1854 than in 1857. In May, 1854, there was about four times as much rain as in May, 1857; but in June and July there was less than half as much, though nearly as many rainy days. The consequence was very much more gross produce per acre, in 1854; and, with the highest manuring, about one-fourth more straw, but scarcely as much corn, as in 1857.

It would appear that the season of 1857 was much more strikingly favourable for the barley crop in the experimental field than, according to the published reports, it was estimated to be in the country generally. Thus, the crop was stated to be, upon the whole, of barely average yield per acre ; though it was admitted to be good in the best corn-growing districts.

Seventh Season, 1858.

The last quarter of 1857 was generally mild, with unusually little rain during the last two months. January, 1858, was also dry, and, during the last fortnight, cold and frosty. February was cold, moderately rainy, with some snow, sharp frosts, and easterly winds, which extended some time into March; in which month there was comparatively little rain. The beginning of April was cold, but most of the remainder fine, and even hot; and a moderate amount of rain fell in the beginning and end of the month. It was also cold in the beginning of May, but fine, dry, and hot towards the end; though with heavy showers, making up about an average fall of rain during the month. June was upon the whole very fine, dry, and hot, with some heavy thunder-showers, but much less than the average amount of rain. In July there was much more rain; and, though variable, the weather was still upon the whole fine and hot. August and September were very fine, with much less than the average fall of rain. Throughout the quarter ending with September, as also in June, the degree of humidity of the atmosphere ranged lower than usual.

There was, therefore, during the winter, spring, and summer, upon the whole, much less than the usual amount of rain; though in February, April, May, and July, there were fair amounts. The air was also generally less humid than usual throughout the summer. The temperature, too, was generally above the average throughout the spring and summer months, whilst June was unusually hot.

Early in the summer the appearance of the wheat plant was generally that of great luxuriance, promising a bulky crop. The reports of the harvest indicated a crop, fully, if not above, the average, though by no means equal to the extraordinary one of 1857. Barley and oats were said to be very various, neither likely to give an average as to quantity; and barley not very good in quality.

The experimental wheat crop was pretty uniformly below the average in quantity of straw, but the produce of grain was generally above the average, and the more so the higher the manuring.

The results obtained with barley are shown in Table VIII. (p. 113).

Hitherto we have been able to show the effects of mixed mineral manure alone, the same with 200 lbs. ammonia-salts, the same with

TABLE VIII.—Quantity and Quality of Barley on Selected Plots.
Seventh Season, 1858.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bush.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	55	54·5	3118	31⅜	6635	88·7
1 O	Unmanured	21⅛	53·0	1207	10⅞	2424	99·1
4 O	Mixed Mineral Manure ..	30⅞	54·0	1780	16⅛	3590	98·3
1 A	200 lbs. Ammonia-salts ..	31½	53·0	1771	15½	3506	102·1
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	51½	54·0	2897	29⅜	6192	87·9
4 A A	Mixed Mineral Manure, and 200 lbs. (1) Ammonia-salts	56¼	53·5	3155	35¾	7160	78·8
4 C	Mixed Mineral Manure, and 1000 lbs. (2) Rape-cake ..	57⅛	53·1	3162	35	7082	80·7

(1) 400 lbs. the first 6 years (1852-7). (2) 2000 lbs. the first 6 years (1852-7).

400 lbs. ammonia-salts, and the same with 2000 lbs. of rape-cake per acre. The crops manured with 400 lbs. ammonia-salts, and 2000 lbs. of rape-cake, were, however, always obviously too heavy to stand up and ripen well in other than most exceptional seasons. For the crop of 1858, therefore, and subsequently, the quantity of rape-cake was reduced from 2000 to 1000 lbs. per acre. The quantity of ammonia-salts applied to the "A A" plots was, at the same time, reduced from 400 to 200 lbs. per acre; and this dressing was continued for ten years, namely, to 1867 inclusive, after which the 200 lbs. of ammonia-salts was substituted by 275 lbs. of nitrate of soda, which is estimated to contain the same quantity of nitrogen. From this time, therefore—1858 and afterwards—any increase of produce on plot 4 A A, over that on plot 4 A, (with only 200 lbs. of ammonia-salts per acre from the commencement), is, doubtless, in great measure, due to an unexhausted residue of nitrogen supplied in the 400 lbs. of ammonia-salts used annually during the preceding six years; and it will afterwards be seen that there was a marked effect from the previous excessive manuring, at any rate over ten consecutive seasons. In like manner, the produce on the plot manured with mineral manure and 1000 lbs. rape-cake in this and subsequent seasons, will be affected by the unexhausted residue from the excessive supply in the first six years.

The seed was sown on March 20; the earlier plots were cut on August 4, and the later ones on August 17. Thus, with a rather limited, but still a sufficient, supply of rain for the requirements of growth, and a comparatively hot summer and harvest period, the crops ripened somewhat early. There was, under most of the conditions of manuring, rather more than the average quantity of straw, more than the average proportion of corn to straw, especially with the most liberal manuring, notably more than the average quantity of corn per acre, and generally good, and full average, weight per bushel. Thus, under varied conditions of manuring, the season of 1858 was, in most particulars, one of more than average productiveness; but, in quantity of total produce, in proportion of corn to straw, and especially in quantity of corn per acre, it was considerably below that of the much hotter and pre-eminently *corn*-yielding season of 1857.

The experimental wheat-crop accorded pretty well in characters with that of the country generally; and the experimental barley-crop has much the characters of the experimental wheat-crop, namely, greater superiority in yield of corn than in produce of straw, when compared with the average; but the barley-crop of the country at large was, according to the reports, by no means so good as that in the experimental field is seen to have been.

Eighth Season, 1859.

The concluding quarter of 1858 was much drier than usual, and, during a considerable portion of it, it was very cold. The latter part of December, however, and January and February, 1859, were very fine and mild; March was also, upon the whole, mild, but with more rain; in April, too, a good deal of rain fell, and the latter part of the month was stormy, wet, and cold. May began with cold, dry, easterly winds; then came a good deal of rain, succeeded by fine and hot weather. During June there were several heavy thunderstorms, much rain fell, and the air was more humid than usual, though there was also some fine warm weather. July was, upon the whole, fine, and unusually hot; but there were several severe thunderstorms at the beginning and about the middle of the month. August was unsettled, but, for the most part, warm, with a good deal of rain. September was also unsettled, and cold, with an excessive amount of rain. In July the dew-point ranged high, but the temperature relatively higher; and, throughout the quarter ending with September, the degree of humidity of the air was below the average.

Thus, throughout the winter there was very little rain; and, with the exception of the early part, the weather was very mild. March was mild, with more rain; in April there was a full, in May a deficient, in June an excessive, in July a moderate, in August a full, and in September an excessive, supply of rain; whilst June and July were considerably above the average temperature, and the harvest period was generally unsettled, with a great deal of rain, and for the most part warm.

Early in the season the reports of the crops were, upon the whole, good; but the heavy rains of June laid the best of them, and the high temperature of that month, but especially of July, induced premature ripening; whilst, owing to the wet and stormy harvest period, and a deficiency of labour, much of them were too long out, and, especially the heavy ones, much damaged. Wheat was eventually pronounced to be under average, much injured, and very poor in quality: barley, a very uneven crop, with very thin grain, and a good deal sprouted; oats also very deficient.

The experimental wheat was unusually bulky with high manuring. With only moderate amounts of ammonia the quantity even of grain was not deficient; but, with heavy dressings of ammonia there was, compared with the average, a considerable deficiency of corn, and a large amount, and very undue proportion, of straw. The weight per bushel of dressed corn was also throughout very low. The following are the results obtained with barley:—

TABLE IX.—Quantity and Quality of Barley on Selected Plots. Eighth Season, 1859.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bush.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	40	52·5	2362	28½	5558	73·9
1 O	Unmanured	13½	49·0	775	9⅛	1800	75·6
4 O	Mixed Mineral Manure ..	19¾	52·5	1197	12¼	2567	87·4
1 A	200 lbs. Ammonia-salts ..	15⅜	47·5	919	11½	2204	71·5
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	34⅝	51·0	2017	27¼	5067	66·1
4 A A	Mixed Mineral Manure, and 200 lbs. (¹) Ammonia-salts	35¾	50·5	2092	30⅝	5517	61·1
4 C	Mixed Mineral Manure, and 1000 lbs. (²) Rape-cake ..	35	51·0	2135	29½	5440	64·6

(¹) 400 lbs. the first 6 years (1852–7). (²) 2000 lbs. the first 6 years (1852–7).

The seed was sown on March 3; and with, upon the whole, mild weather, and a good deal of rain, for a couple of months, succeeded by heavy thunderstorms, but a considerable amount of hot weather, the crop came forward very early, the plots manured with superphosphate being cut on July 13, and carted on August 1; whilst the remainder were not cut until August 8, and were carted on August 12. With the wet spring, and premature ripening summer, there was a considerable deficiency of total produce, which showed itself proportionally much less in the straw where the manure was liberal than where it was defective. The deficiency in quantity of corn was throughout very great, and the weight per bushel was also throughout low, and very low where superphosphate was not employed. The deficiency was the greatest in both corn and straw, and particularly in corn, where the ammonia-salts were used alone; that is to say, where there was the greatest excess of ammonia relatively to the supply of mineral constituents. The quantity of corn under that manuring was less than half, and that of the straw less than two-thirds, the average; and both corn and straw were absolutely less than in any either preceding or succeeding season, though this was only the eighth year of the twenty in which no mineral manure had been applied on that plot. Next to the plot manured with ammonia-salts alone, that continuously without manure was proportionally the worst in this season, compared with the average.

Thus, the general characters of the experimental barley crop, agree with those of the experimental wheat, in showing considerable deficiency; greater deficiency in corn than in straw, and greater where the manurial conditions were the most defective. The spring-sown barley suffered, however, more than the autumn-sown wheat; being not only more deficient in corn, but generally deficient in straw also, which the wheat crop was not. The comparatively greater deficiency of total produce of the barley, is probably due to the wet and warm weather, almost from the time of sowing. Sowing early would induce too much upward, and too little underground growth, thus leaving the plant without proper soil-resources in its later stages. The character of the experimental barley accords with that of the country generally, which, as has been seen, was stated to be uneven, prematurely ripened, and to yield thin grain, often sprouted.

Ninth Season, 1860.

The last quarter of 1859 was very variable as to temperature, but prevailingly cold; and upon the whole wet. January 1860, was variable, but generally mild and wet; February was very cold, with sharp frosts and snow, ending with storms of rain and wind. The greater part of March was cold, with heavy showers, and snow; the remainder was finer and warmer. April was very cold, with some snow and sharp frosts; the beginning of May was also cold, but the rest of the month warmer than usual, though very wet. June was very cold and very wet; July also very cold, with a moderate amount of rain, most of which fell after the middle of the month; August cold and very wet, and September also cold, but fine in the early part, though very wet in the latter. In June, July, August, and September, the dew-point generally ranged low; but with the unusually low temperatures, the degree of humidity of the air was considerably above the average.

Thus, the winter was alternately very mild and very cold, and upon the whole very wet. The spring, summer, and autumn, were very stormy, cold, wet, and unseasonable; indeed, more so than had been known for many years past.

The crops were very backward, and the harvest 2, 3, or more, weeks later than usual. Wheat was, in some localities, not deficient in bulk, but generally very much damaged, yielding but a small proportion of grain, and that of very low quality. The crop was, indeed, very much below the average, both in quantity and quality. Barley and oats were reported to be bulky, and generally abundant; but barley especially in many districts much laid and damaged, and giving grain of inferior quality.

Under the influence of the extraordinarily wet and cold growing and ripening season, the wheat-crop in the experimental field was very much below the average both in quantity and quality, though the deficiency was proportionally less with the heavier dressings. The crop was generally worse than any other, excepting that of 1853. The following results were obtained in the experimental barley field:—

Table X.—Quantity and Quality of Barley on Selected Plots. Ninth Season, 1860.

Plots.	Manures, per Acre.	Produce per Acre, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bush.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	41⅜	52·1	2319	25⅜	5156	81·7
1 O	Unmanured	13¼	50·8	753	7½	1598	89·1
4 O	Mixed Mineral Manure ..	18¼	51·3	1013	9⅝	2093	93·8
1 A	200 lbs. Ammonia-salts ..	26⅝	50·8	1501	14⅞	3166	90·2
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	43½	51·1	2375	26⅝	5355	79·7
4 A A	Mixed Mineral Manure, and 200 lbs. (1) Ammonia-salts	46¼	51·0	2501	29	5746	77·1
4 C	Mixed Mineral Manure, and 1000 lbs. (2) Rape-cake ..	40¾	51·1	2238	22¾	4783	87·9

(1) 400 lbs. the first 6 years (1852–7). (2) 2000 lbs. the first 6 years (1852–7).

Bad as were the seasons of both 1859 and 1860, yet they show some remarkable contrasts. 1859 was wet, much rain falling in heavy storms, unusually warm, and very early, some of the plots in the experimental barley field being cut on July 13th. On the other hand, 1860 was wet, the rain a good deal distributed, unusually cold and sunless, all crops were very late, and the experimental barley, which was sown on March 19th, was not cut until September 3rd and 4th. In the wet, warm, and early season of 1859, there was a very great deficiency of corn, low weight per bushel, and comparatively little deficiency of straw, especially where the manuring was liberal. In the wet, cold, and late season of 1860, there was much less deficiency of corn, especially with liberal nitrogenous manuring, about as low a weight per bushel as in 1859, and a somewhat greater, but still not great, deficiency of straw. The wet, cold, and late season, gave, therefore, upon the whole, a much better crop, and especially much more corn, with liberal nitrogenous manuring, than the wet, warm, and prematurely early season.

This result is very instructive, when it is borne in mind that it is with high temperature, provided there be a sufficiency and not an excess of rain, that nitrogenous manures the most strikingly increase the produce of grain. We have here an illustration of the dependence of the result on the mutual adaptations of heat, moisture, and stage of growth of the plant, and of how difficult it is, without going into considerable detail as to each of these three elements, and their relations to one another, thoroughly to anticipate, or to explain, the influence of any particular season. It will be remembered that the very remarkable productiveness of 1854, was by no means clearly indicated in the general characters of the season, as represented in the summary statement of the meteorological registry for the period. Doubtless, an influential element of the restricted productiveness in 1859, with the higher temperatures, was the fact of their distribution being such as to bring the plant much too early to maturity, thus shortening its period of accumulation and growth. On the other hand, the much better result with the wet and cold season of 1860, was probably greatly due to the less active above-ground, and probably greater under-ground development, early in the season, and to a much more extended subsequent period of growth.

It is worthy of remark that, whilst, with mineral manures and ammonia-salts or nitrate of soda, the experimental barley crop was so much better in yield of grain in 1860 than in 1859, the experimental wheat-crop was, with similar manures, much the most deficient, both in corn and straw, in 1860. The winter-sown wheat having acquired much more complete possession of the soil than the spring-sown barley, the high temperature of the summer of 1859 would in a much less degree check its luxuriance and induce premature ripening—that is much less curtail its total growth—and hence, with liberal nitrogenous manuring we have, in its case, though a deficiency of corn, an even more than average total produce in the hot, but upon the whole wet, season of 1859; whilst with the barley there is a considerable deficiency of total produce, and more deficiency of corn than of straw. In the wet sunless season of 1860, on the other hand, the wheat, which requires higher temperatures for its luxuriance than barley, shows a great deficiency of total produce, more especially in the straw; and the barley less deficiency of total produce, and very much less deficiency of corn than in 1859. Lastly, it is remarkable, that although under the influence of the rapidly active artificial manures, there was such unusual deficiency of barley grain in the hot and early season of 1859, yet in the same season, the much less rapidly active, but much more comprehensive, manuring of farmyard dung gave a much less marked deficiency.

The results in the experimental fields are in accordance with the records of the crops in the country at large, in showing 1860 to have been for wheat a more, but for barley a less, adverse season than 1859.

Tenth Season, 1861.

October, 1860, was upon the whole seasonable; November very cold, with a good deal of rain; December mild at the beginning, but otherwise, as also the greater part of January (1861), extremely severe. Many evergreens of long standing were killed during this period. The remainder of January and February were much milder, with comparatively little rain; though during the latter month, as also pretty continuously through March, April, and the beginning of May, there was a good deal of cold wind, with less than the average fall of rain. The remainder of May was dry and fine, and even hot. June commenced with cold wind and rain, followed by an interval of fine and hot weather, and then a good deal of rain to the end of the month. July was generally seasonable as to temperature, with less than the average fall of rain. There was some heavy rain at the beginning of August, but, upon the whole, the month was very dry, fine, and favourable; and the fine weather continued, but with rather lower temperatures, and much wind, till nearly the end of September, when a considerable quantity of rain fell. In June, both the dew point and degree of humidity of the air ranged high; but in July, August, and September, they were not far from the average.

Thus, after, upon the whole, a favourable autumn seed-time, the winter of 1860–61 was unusually severe, and the young wheat-plant suffered considerably. The spring of 1861 was for the most part dry, with a good deal of cold wind; but plentiful rains, and some hot weather, in June, brought the growing crops rapidly forward; July, August, and the greater part of September, were, upon the whole, seasonable as to temperature and degree of humidity of the atmosphere, with less than the usual amount of rain.

The wheat crop was reported to be generally below the average in quantity per acre, owing chiefly to the loss of plant during the winter; but it was much improved by the favourable weather of the latter part of the summer, and the autumn; and a fair average, and, in many cases, good quality, compensated somewhat for deficiency of quantity. Spring corn crops were, however, stated to be generally good; both barley and oats, especially the latter, yielding very well.

The experimental wheat crop was considerably deficient in straw, and somewhat so in grain; but the quality of the latter was fully equal to the average. The crop was, however, in all respects superior to that of 1860; and generally in yield, but especially in quality of grain, superior to that of 1859 also.

The selected plots in the experimental barley-field gave the following results:—

TABLE XI.—Quantity and Quality of Barley on Selected Plots. Tenth Season, 1861.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bush				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	54⅜	54·8	3169	31⅝	6715	89·4
1 O	Unmanured	16¼	52·3	941	11	2166	76·8
4 O	Mixed Mineral Manure ..	29⅜	54·0	1648	15⅜	3366	95·9
1 A	200 lbs. Ammonia-salts ..	30½	51·5	1745	19⅝	3945	79·3
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	54⅝	54·0	3059	30½	6472	89·6
4 A A	Mixed Mineral Manure, and 200 lbs. (¹) Ammonia-salts	55⅞	53·5	3169	33⅝	6937	84·1
4 C	Mixed Mineral Manure, and 1000 lbs. (²) Rape-cake ..	53⅝	54·3	3111	31	6576	89·8

(¹) 400 lbs. the first 6 years (1852–7). (²) 2000 lbs. the first 6 years (1852–7).

Without manure, there was less than the average amount of both corn and straw; but, with every description of manure, there was more than the average quantity of straw, and with every description (excepting by ammonia-salts alone) more than the average quantity of corn; and with liberal manuring, whether in the form of farmyard dung, rape-cake, or mixed mineral manure and ammonia-salts, considerably more. The weight per bushel of dressed corn was also, in most cases, fully equal to the average.

Thus, although the winter-sown wheat had given less than an average yield, the spring-sown barley gave much more than an average. The wheat had suffered from the severity of the winter, which would doubtless be favourable, rather than otherwise, so far as the condition of the land for the barley was concerned. Both were subjected to the influence of a dry, cold, and backward spring, which would tend to root-development rather than early aboveground luxuriance. Plentiful rains following in June, and again at the beginning of August, with, upon the whole, seasonable temperatures throughout the greater part of June, July, and August, conditions favourable for both crops were supplied. Hence, notwithstanding a deficient plant, the wheat turned out better than was expected; and the barley being not too forward in its early stages, and, under the conditions of season, probably well rooted, gave, upon the whole, a much more than average crop, especially of grain. It should be added, that the riper crops, those with superphosphate of lime in the manure, were not cut until August 20th and 21st, and the remainder not until August 27th. The earlier crops were, for the most part, a little laid, but none seriously.

It will be seen that these results, obtained in the experimental fields, accord very well with those reported in regard to the crops of the country at large.

Eleventh Season, 1862.

October, 1861, was generally mild, fine, and dry; November inclement, with an excess of rain, and unusually low temperature. December was, upon the whole, warmer and drier than the average, but with a good deal of cold wind towards the end. January and February (1862) were, upon the whole, fine and dry, with a good deal of warmer, and but little of colder, weather than usual. The beginning of March was frosty, but the greater part unusually mild and wet. April was variable, with some unseasonably cold, but a good deal of warm, weather; and a full average amount of rain. May was extremely wet, and, in the early part especially, unusually warm. June, July, and August were, almost throughout, unsettled, with a good deal of wind and rain, and unusually low temperatures, the nights especially being frequently very cold; and although the atmosphere contained less than the average actual amount of moisture, the degree of humidity of the air was, with the low temperatures, not correspondingly low. September was also variable, with a good deal of rain at the beginning and end of the month, but with fine and warm weather intermediately.

The winter of 1861–2 was, therefore, upon the whole, mild. The spring was variable as to temperature, upon the whole warmer than usual, and very wet. The summer was unsettled, stormy, cold, and wet.

The wheat crop of the country was almost universally reported to be under the average, in many cases root-fallen, and also much mildewed. Barley was stated to be about, or scarcely, an average; oats a fair average.

The experimental wheat crops were, where the manuring was not excessive, fully equal to the average in both quantity and quality of grain, but, upon the whole, barely average in amount of straw.

The following results were obtained in the experimental barley-field:—

Table XII.—Quantity and Quality of Barley on Selected Plots. Eleventh Season, 1862.

Plots.	Manures, per Acre.	Produce per Acre, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bush.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	49¾	54·8	2936	34¼	6774	76·5
1 O	Unmanured	16½	50·3	899	9¾	1987	82·6
4 O	Mixed Mineral Manure ..	25⅛	52·0	1428	13½	2941	94·4
1 A	200 lbs. Ammonia-salts ..	31⅜	49·4	1821	20⅜	4106	79·7
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	47⅝	54·0	2725	31⅝	6273	76·8
4 A A	Mixed Mineral Manure, and 200 lbs. (¹) Ammonia-salts	48¾	54·0	2824	33⅛	6529	76·2
4 C	Mixed Mineral Manure, and 1000 lbs. (²) Rape-cake ..	45½	54·0	2634	28⅞	5872	81·4

(¹) 400 lbs. the first 6 years (1852–7). (²) 2000 lbs. the first 6 years (1852–7).

As has been stated, March was unusually wet; the seed was not sown until April 16th; the earlier plots (those with superphosphate) were not cut until August 22nd, and the remainder not until September 1st. Excepting without manure, and with mineral manure alone, the quantity of barley-grain per acre was either close upon, or over, the average of the 20 years; and the weight per bushel of dressed corn was also, in most cases, fully or over the average. The superiority was the most marked with farmyard-manure; and with it there was the greatest excess of straw as well as corn. With rape-cake, on the other hand, there was a slight deficiency of both straw and corn, the crops being more laid than any of the rest. With the more liberal artificial manures there was, however, fully or over the average quantity of both corn and straw. Upon the whole, therefore, notwithstanding the prevailing coldness and wetness of the summer, the experimental barley-crop was somewhat over average, in both quantity and quality, under liberal conditions of manuring. The barley-crop of the country generally was pronounced to have been much less injuriously affected than wheat, and to have been about, whilst the latter was seriously below, the average. The experimental wheat, however, as well as the experimental barley, turned out to be rather over the average.

Twelfth Season, 1863.

October, 1862, was unusually warm, but with a good deal of wind and rain. November was cold, with comparatively little rain. December, and January and February 1863, were unusually mild, with a fair amount of rain in December, a good deal in January, and but little in February. March was, upon the whole, mild, with but little rain, and wheat showed unusually forward growth. April was very dry and warm. In May there were some refreshing rains, though only a small total fall, but the temperature was occasionally extremely low, and pretty nearly throughout rather below the average, with frequent storms of wind. The temperature in June was also generally rather below the average, and there was a great deal of rain, which, though needed, and much aiding growth, was so heavy as to lay the most forward and bulky crops. In July there was much less rain than usual, with moderately high day but low night temperatures, and some sharp night frosts. August, with only moderate temperature, and about the usual amount of rain, was, upon the whole, favourable for ripening and for harvest. In September a good deal of rain fell, and the temperature ranged rather low. In June the eondition of the atmosphere as to moisture was about the average for that month. In July, August, and September, both the actual amount and the degree of humidity were below the average.

Thus, the winter and early spring were generally very mild, with, upon the whole, less than the usual fall, but in January an excess of rain. The remainder of the spring included some warmer, but more colder weather than usual, and there was, upon the whole, a deficiency of rain. The early summer was also cool, with more, and some heavy rain. From that time to harvest, though the temperature was seldom high, it was (excepting some night-frosts in July) generally suffieient, the fall of rain was considerably below the average, and the atmosphere comparatively dry.

With these characters of season, the wheat crop of 1863 was almost unanimously reported to be considerably above the average, both in quantity and quality. Indeed, such a yield per acre had not been known for very many years. The plant came very early forward, had refreshing though limited rains in its early stages, received comparatively few checks, and with a somewhat cool but sufficiently warm summer, with little rain and a comparatively dry atmosphere during the latter stages of growth, and the ripening and harvest periods, there was a lengthened and almost unbroken course of gradual accumulation. Spring-sown crops, especially barley, were reported to be less uniformly good—those that were late sown having suffered for want of rain in the early stages of growth. Still, both barley and oats were considered to be rather over the average.

The experimental wheat crop of 1863 was the twentieth in succession on the same land, yet it proved to be in quantity of both grain and straw by far the most productive, and in quality of grain nearly the best, hitherto. It even considerably exceeded both 1854 and 1857, which also were years of extraordinary yield. It was a very favourable season for the action of ammonia-salts, giving more total produce, and especially more corn, for a given amount of ammonia applied, than was obtained in any other year. The following are the results obtained on the selected plots in the experimental barley field:—

TABLE XIII.—Quantity and Quality of Barley on Selected Plots. Twelfth Season, 1863.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bush.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	59½	57·2	3473	33⅛	7185	93·6
1 O	Unmanured	22⅞	53·6	1276	11⅛	2545	100·5
4 O	Mixed Mineral Manure ..	33	54·8	1868	15⅜	3596	108·7
1 A	200 lbs. Ammonia-salts ..	42⅝	53·6	2406	21⅜	4806	100·3
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	55⅜	56·5	3210	32	6791	89·6
4 A A	Mixed Mineral Manure, and 200 lbs. (1) Ammonia-salts	59½	56·4	3429	34¾	7323	88·1
4 C	Mixed Mineral Manure, and 1000 lbs. (2) Rape-cake ..	54½	56·7	3159	30¾	6599	91·8

(1) 400 lbs. the first 6 years (1852–7). (2) 2000 lbs. the first 6 years (1852–7).

The barley was sown on March 11; the forwardest plots were cut on August 10 and carted on August 14, and the remainder cut on August 15 and carted on August 24. The seed was in, therefore, though not early, still in good time; and, with a mild but comparatively dry spring, the plant would probably distribute its feeders well through the soil, and with liberal rain in June, but no unduly forcing weather at any time, and favourable ripening and harvest periods, the result was, though not as with wheat in all respects the best crop hitherto, still one much over the average. It was so, especially in quantity and proportion of grain, whilst in quality, indicated by weight per bushel, it was actually the best up to that time; but, as will be seen, it has been exceeded on this point in several seasons since. In quantity of straw it was also over average. As in the case of wheat, the season was peculiarly favourable for the action of ammonia-salts—indeed, for all high manuring—the farmyard manure giving not only considerably more than average total produce, but, both as to quantity and quality of corn, a better result than in any other season hitherto. Without manure, or with purely mineral manure, the amount of produce of both corn and straw has been exceeded in several seasons; but with mineral and nitrogenous manures together, the only years that exceeded or closely approached 1863 were, in produce of corn, 1854, 1857, and 1864; but, in produce of straw, 1854 the most strikingly, and less so 1855, 1861, 1862, 1864, 1869, and 1871.

A comparison between the characters of the seasons of 1854 and 1863, the former yielding, with high manuring, generally fully as much or more corn, and considerably more straw than the latter, will usefully illustrate upon what conditions the very favourable, but still very different results of the two seasons depended. In 1854, which gave much the larger quantity of total produce of barley (corn and straw together), the winter having been very severe, the land was worked and the seed was sown very early; there was considerably less than half the average amount of rain in March, April, June, and July, with nearly double the usual amount in May. In 1863, on the other hand, the seed was not in so early; there was only about half the usual amount of rain in March, April, May, and July, with nearly double the usual amount in June. In both years there was in August about the average amount of rain. Almost throughout the six months enumerated, 1863 was slightly the warmer of the two, though both were rather warmer than usual in the early spring, and rather cooler than usual, but with a dry atmosphere, in the summer. Thus, both seasons were, throughout the greater part of the period of growth, comparatively dry and temperate; but each had, at one period, a large fall of rain, which, in 1854, yielding the largest amount of total produce, came in May, whilst in 1863 it did not come until June. It is worthy of remark, that with the winter-sown wheat the result was reversed; for with it the larger produce of both corn and straw—indeed the largest ever obtained—was in 1863. The difference is, however, explicable by the very different characters of the winters in the two cases. The winter of 1853-4 was unusually severe, and the wheat-plant backward in the early spring; whereas the winter of 1862-3 was mild, with a good deal of rain in January, and the plant was very forward in the spring. It would, therefore, the less require liberal rains before June than the spring-sown barley, and would be in a better state for benefitting by the generally favourable climatic conditions of the spring and summer than the less forward wheat-plant of 1854.

Thirteenth Season, 1864.

October, November, and December, 1863, were warmer than usual, with about, but upon the whole, less than the average amount of rain. January and February, 1864, though including some abnormally warm intervals, embraced longer periods of very cold and wintry weather, which checked forward vegetation; there was considerably less than the average fall of rain in January, and a very small fall, including snow, in February. In March the rainfall was large—the first half of the month generally warm, the latter half cold—and, upon the whole, the quarter had been very variable, colder than usual, with many alternations from frost to thaw. April and May were, for the most part, warm, with less than the average amount of rain; but the end of May and nearly the whole of June were comparatively cold, but with little rain. There was very unusually little rain in July and August, but an excess in September. The day-temperatures generally ranged high in July, but about the average in August and September; whilst the night-temperatures were somewhat below the average in July, much below in August, and about the average in September. In June and July the dew-point was below, and in August very much below, the average. The degree of humidity of the air was in June low, in July about the average, and in August very remarkably below the average.

Thus, the winter was very variable, including a good deal of warm, but also much very cold and wintry weather, though with comparatively little rain. The spring, though changeable and wet at the beginning, was, upon the whole, warm and dry; June was cold and dry, whilst the rest of the summer was hot in the day and cold at night, with very little rain, and in August especially a very dry atmosphere.

The wheat crop of the country proved to be, in quantity, much above the average on good soils, but below the average on poor soils, and in quality generally above the average. Barley was reported to be very unequal—good on good soils, stunted and poor on light soils—and, owing to the summer drought, the early generally much better than the late sown; upon the whole, however, over average. Oats irregular, short, deficient in yield, and generally much below average in quantity. Roots generally a failure.

The experimental wheat crop, though by no means equal to the extraordinary one of 1863, was nevertheless considerably above the average both in quantity and quality of grain, especially under liberal manuring; it was also much above the average in quantity of straw. The following results were obtained in the experimental barley field :—

TABLE XIV.—Quantity and Quality of Barley on Selected Plots. Thirteenth Season, 1864.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bush.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	62	57·4	3672	37⅜	7852	87·8
1 O	Unmanured	24	55·7	1379	12¾	2809	96·4
4 O	Mixed Mineral Manure ..	33¼	57·3	1949	16¾	3829	103·7
1 A	200 lbs. Ammonia-salts ..	38⅞	55·4	2258	20⅜	4533	99·2
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	55⅝	57·6	3316	34⅞	7225	84·8
4 A A	Mixed Mineral Manure, and 200 lbs. (1) Ammonia-salts	56⅜	57·6	3299	37¼	7469	79·1
4 C	Mixed Mineral Manure, and 1000 lbs. (2) Rape-cake ..	53	57·2	3153	34⅞	7061	80·7

(1) 400 lbs. the first 6 years (1852–7). (2) 2000 lbs. the first 6 years (1852–7).

The seed was sown on March 26th, the most forward plots were cut on August 11th, and carted on August 13th; and the remainder cut on August 17th, and carted on August 18th. The sowing was, therefore, rather late; but, with a hot and dry ripening period, the harvest was moderately early. There had been a good deal of rain in March; but, from that time up to harvest, very little. With the exception of June, which was cold, the spring and summer were generally warm, and the ripening period characterized by a very dry atmosphere. Notwithstanding the prevailing warmth and dryness of the growing periods, all the experimental plots gave very considerably more, of both corn and straw, than the average. Of corn there was generally more than in any other year of the 20, excepting 1863 and 1854; and with farmyard manure, by the use of which there is so much accumulation in the soil, more than in any year of the 20. The weight per bushel was also much above the average; throughout higher than in 1863, with few exceptions as high as, and in some cases higher than, in any other year. The experimental barley crop was, therefore, one of large produce of straw, indicating considerable luxuriance of growth; of exceptionally large produce of grain, which was of very exceptionally high quality. It is probable that, with the wet March, the plant found sufficient moisture in the soil for the requirements of its early growth; that, owing to the distribution of the comparatively small total fall during the rest of the season, it was sufficient under those preliminary conditions; that the low temperature of June prevented over luxuriance; that the cold nights, alternating with the hot days, of July, prevented premature ripening; and that the dry atmosphere during the final stages contributed to the high perfection of the grain.

These very favourable results in the experimental field are not inconsistent with the record of the barley crops in the country at large; for though it was admitted that on light soils, and where sown late, the crop was very poor, it was equally admitted that, under more favourable conditions in these respects, it was very good.

Fourteenth Season, 1865.

After a rather wet September, but a very low aggregate rainfall during the first 9 months of the year, the concluding quarter of 1864 was also characterized by less rain than usual. The deficiency was very considerable in October and December, though there was rather an excess in November. As to temperature, the period was very variable, with a good deal of cold weather. There were occasionally very high winds; whilst the degree of humidity of the air was very unusually low in October, and somewhat low in November and December also. In January, 1865, there was a considerable, and in February a slight excess, but in March a deficiency of rain (including snow); though, throughout the quarter, the number of rainy days was small. Excepting the first half of January, the greater part of which was warm, the quarter was almost throughout unusually stormy and cold, with a good deal of snow; March in particular was generally very exceptionally cold and inclement. In April and June very little rain fell; whilst in May and July there was an excess, and in August a very great excess. In September, however, the fall was very exceptionally small. April, May, and the beginning of June, were much warmer than the average, but the remainder of June was variable, and, upon the whole, rather cold. The mean temperature of the quarter, and especially of April, was, however, the highest on record for that period of the year; and the air was pretty uniformly much drier than the average; the rain which fell being little distributed, coming for the most part in heavy showers. July, with an excess of rain, was also warmer than usual. The greater part of August was not only extremely wet, but rather colder than usual; whilst September was both the driest and hottest on record; completing, notwithstanding the comparatively low temperature of August, a hotter period of 6 months than any other known. In each month, too (excepting August, when it was very high), the degree of humidity of the air was generally very low.

The winter of 1864-5, though variable, was, therefore, upon the whole, very cold, stormy, and inclement; the early spring unusually cold and backward; but the remainder, and greater part, was very warm, with a dry atmosphere; though, towards the end, some heavy rains fell, and the combined conditions brought the crops very rapidly forward. June was also dry, hot at the beginning, though afterwards comparatively cool; July was hot, with a good deal of rain, but, upon the whole, a dry atmosphere; the greater part of August was cool and very wet, but the remainder, and September, very hot and dry, favouring the rapid completion of the hitherto much retarded harvest work. Thus, after a severe winter and late spring, the growing period was characterized by great heat, dryness of atmosphere, and a deficient amount and distribution of rain; the ripening period by an excess of rain, followed, however, by an eventually favourable, though late harvest time.

The wheat crop of the country was reported to be very variable; good on clays and land in good condition, but poor on light and badly farmed soils; in the aggregate about, or slightly under, average as to quantity; variable, and, upon the whole, only moderate in quality. Barley was said to be the best of the cereals, but inferior on light lands; oats the poorest crop for many years past.

The experimental wheat crop was, in quantity of corn, much below the average on the poorly manured, but considerably above it on the highly manured plots. The weight per bushel of dressed corn was, throughout, above the average; but the quantity of straw was almost throughout considerably below average, though proportionally the less so the higher the manuring. The results obtained in the experimental barley-field are shown in Table XV. (p. 130).

The wintry weather of March delayed all spring sowing, and the experimental barley was not put in until April 6th. On the other hand, the prevailing heat and drought of the spring and summer, brought grain crops early forward, and the whole of the

TABLE XV.—Quantity and Quality of Barley on Selected Plots.
Fourteenth Season, 1865.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bush.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	52¾	54·4	2923	25⅜	5769	102·7
1 O	Unmanured	18	53·9	1018	8⅛	1924	112·3
4 O	Mixed Mineral Manure ..	24⅜	54·0	1349	10	2464	121·0
1 A	200 lbs. Ammonia-salts ..	29⅞	53·8	1666	13	3127	114·0
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	46½	53·5	2549	22½	5075	100·9
4 A A	Mixed Mineral Manure, and 200 lbs. (1) Ammonia-salts	48⅞	53·3	2684	24⅞	5469	96·4
4 C	Mixed Mineral Manure, and 1000 lbs. (2) Rape-cake ..	48⅛	53·5	2648	22	5117	107·2

(1) 400 lbs. the first 6 years (1852–7). (2) 2000 lbs. the first 6 years (1852–7).

barley was cut on August 9th; but, owing to the wet weather which had then set in, it was not carted until August 18th. As might be expected from the characters of the season, and as was consistent with the results obtained in the experimental wheat field, there was throughout a considerable deficiency of total produce (corn and straw together), which was proportionally the greater the poorer the conditions as to manuring. There was, however, a very high proportion of corn to straw, the higher the poorer the manuring; and the weight per bushel of dressed corn was about the average. As to the actual amount of corn per acre, it was, without manure, with mineral manure alone, and with ammonia-salts alone, considerably below the average, but much nearer the average with the more complete manuring. The result is, then, that with a deficiency in total amount of rain, the very unequal distribution of that which fell, the very dry atmosphere, and the unusually high temperatures almost throughout the periods of growth, the conditions above ground were adverse to luxuriance, but very favourable to seeding tendency and maturation; and, where the conditions supplied within the soil were the most defective, the root-range would doubtless be the most restricted, and the plants would suffer the most; whereas, where the conditions supplied within the soil were liberal, a more extended root-range would render the plant less sensitive to the atmospheric heat and drought; and, hence, proportionally less failing in luxuriance.

The characters of both the experimental wheat and experimental barley-crops were, therefore, in the main accordant with those of the respective crops in the country at large. That is, the results in the experimental fields varied greatly according to the conditions of manuring; the crops suffering most where the conditions of manuring were the most defective, whilst it was on the light and badly farmed lands that the crops of the country suffered most. On the other hand, it was under the influence of liberal manuring that the quantity of corn was proportionally the highest in the experimental fields, and it was on the clays, and better farmed lands, that the crops were good in the country generally.

Fifteenth Season, 1866.

The very warm and dry weather of September, 1865, extended through the first week of October; and, although there were a few cold intervals, the temperatures of the three concluding months of the year ruled higher than the average; December, especially, being unusually warm. The period included, however, very great fluctuations in barometric pressure, and some extremely severe storms of wind; whilst in October a very excessive, in November a full, but in December a deficient, amount of rain fell. January and the first half of February (1866) were also unusually warm, though in January there was a heavy fall of snow, which, however, rapidly thawed, and the whole period was very wet. A cold and drier period then set in, and extended to the middle of March, checking the hitherto much too forward vegetation; and then, to the end of the quarter, the temperatures, though variable, ruled, upon the whole, very high, and there was a full amount of rain. The beginning of April was cold and rather wet, and the remainder considerably warmer and drier than the average. May was, throughout, unusually cold both day and night, and there was a deficiency of rain. June was changeable, but included a good deal of hot weather, which raised the mean temperature above the average, and during the month a considerable excess of rain fell. The beginning of July was cold and wet; then followed a week of hot and dry weather; but, from about the middle of the month to nearly the end of September, the weather was, with the exception of few and short intervals, generally cold, with a good deal of rain and wind in August, and an almost continuous and considerably excessive fall in September. October was, however, upon the whole, warmer and drier than usual. In June, July, August, September, and October, the degree of humidity of the air was generally high.

Thus, after a very wet and comparatively warm autumn, the winter was, until the middle of February, unusually warm, with a great deal of rain, inducing premature luxuriance of grass and winter-sown crops; then came a month of cold and dry weather, checking growth. The remainder of the spring was at first very variable, but May was unusually cold and dry. The early summer was changeable, but mostly warm, with a good deal of rain; and the ripening and harvest periods were almost continuously cold and rainy, with a moist atmosphere, but with occasional high and drying winds.

After the winter the wheat-plant was very forward, but was much checked by the prevailing, though not continuous, coldness and dryness of the spring. Recovering, and showing fair promise in early summer, it was again checked by the sunless weather, and in many cases laid and damaged by the wet maturing and harvest period. The harvest was protracted and late; and the crop was eventually pronounced to be below an average in quantity, though of fair quality. Barley and oats were said to be very variable; in some cases poor, in others much damaged; but upon the whole, above average in quantity, and in some districts harvested in good condition, and of good quality.

The experimental wheat-crop was, under all conditions of manuring, below the average in quantity of corn; and, excepting under the highest manuring (when it was considerably above), below the average in quantity of straw also. The weight per bushel was, however, over average. The following results were obtained in the experimental barley-field:—

TABLE XVI.—Quantity and Quality of Barley on Selected Plots. Fifteenth Season, 1866.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bush.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	53⅛	54·9	3065	31½	6594	86·8
1 O	Unmanured	15⅞	51·1	858	9½	1928	80·1
4 O	Mixed Mineral Manure ..	24	52·7	1323	12⅞	2759	92·1
1 A	200 lbs. Ammonia-salts ..	27⅛	50·9	1474	15⅜	3200	85·4
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	47	54·7	2636	27⅜	5704	85·9
4 A A	Mixed Mineral Manure, and 200 lbs. (¹) Ammonia-salts	50⅞	55·4	2954	28¼	6117	93·4
4 C	Mixed Miueral Manure, and 1000 lbs. (²) Rape-eake ..	48⅝	55·6	2834	27⅝	5929	91·6

(¹) 400 lbs. the first 6 years (1852–7). (²) 2000 lbs. the first 6 years (1852–7).

The seed was not sown until April 2nd. The whole of the plots were cut on August 15th, 16th, and 17th; the earliest were carted on August 18th, but the remainder not until August 23rd and 24th. With, upon the whole, a dry and backward spring; a changeable, but mostly warm and wet, early summer;

but cold, wet, and windy ripening and harvest period, the result was considerably less than the average produce of both corn and straw without manure, and with defective manuring; but fully average quantity of corn, and not much less than average quantity of straw, with the more liberal artificial manuring. The farmyard manure, indeed, gave more than its average of both corn and straw; but, as will be seen further on, the produce on the farmyard manure plot increased very much during the later years of the experiment, so that the result must not be attributed exclusively to the season. The weight per bushel of dressed corn is seen to vary very considerably under the different conditions of manuring. Thus, without manure, and with ammonia-salts alone, the weight per bushel was considerably below the average under those conditions; whilst, with the more complex and more perfect artificial manures, and with the farmyard manure—that is with the more liberal soil-conditions—it was considerably above the average.

The smaller deficiency, if any, in total produce, and the higher quality, under high manuring, and the greater deficiency, and the poorer quality, under the poorer soil-conditions, are consistent with the results obtained in the experimental wheat-field, and also consistent with the character of great diversity given of the spring-sown crops of the country at large.

The season of 1866, with its late spring, its warm and wet early summer, but prevailing cold and wet later growing and ripening periods, gave considerably greater bulk of produce than 1865, with its also late spring, but warm and dry growing period. Though both seasons were unfavourable, they were essentially different in character. Yet they agree in this: that each was relatively less unfavourable with high than with poor manuring. The more perfect soil-conditions enabled the plant the better to withstand the heat and dryness in 1865, and the prevailing cold and wet of the growing and ripening period in 1866. That the quality of both wheat and barley was not worse in 1866, notwithstanding the cold and wet ripening period, was greatly due to the drying winds which alternated with the rains; but the much higher, indeed, the really high quality of the barley grown by liberal manuring, shows how much more vital power the plants growing under the more favourable soil-conditions possessed, and that in a certain degree those conditions compensated for the lacking favourable atmospheric conditions.

Sixteenth Season, 1867.

Though including some cold intervals, the concluding quarter of 1866 was generally warmer than the average, with somewhat less than the usual aggregate amount of rain, though a good deal fell within a short interval about the middle of November, causing floods, and hindering autumn sowing in some localities. In January, 1867, the fluctuations were very great; extreme cold and heavy falls of snow, alternating with rapid thaws, warm weather, heavy gales, and a good deal of rain. The last week of January, and almost the whole of February, were very unusually warm, with a large amount of rain at the beginning, and a moderate quantity over the rest of the period. March, again, was almost to the conclusion very cold and wintry, with a good deal of snow. Throughout the quarter there was a succession of gales of wind. Owing to the severe weather of March, the growth of winter-sown crops was checked; and owing partly to the wetness, and partly to the frost, the preparation of the land for spring-sowing was much retarded. April, and the beginning of May, were very unsettled; stormy, rainy, and changeable as to temperature; but, on the average, warmer than usual. Later in May, besides some very warm, there was a longer period of extremely cold weather, with a dry atmosphere, and frosty nights, much checking vegetation; though, during the month, there was rather more than the average fall of rain. June was comparatively dry, very changeable as to temperature, but on the average colder than usual. The cold weather continued throughout July and the beginning of August, and the period was generally sunless and cloudy, with an excess of rain in July, which fell very heavily towards the end of the month, and much laid, and in some cases inundated, the crops. The remainder of August, and September, were much finer, rather warmer than the average, though with rather more than the average fall of rain; which, however, was not much distributed, but fell for the most part in considerable quantities at a time.

Thus, the early winter was, upon the whole, warmer and drier than usual; then came intervals of severe frost, snow, and heavy gales, followed by several weeks of very warm weather, with a good deal of rain. The early spring was very wintry and stormy, and both growth and spring-sowing were retarded. The remainder was very changeable as to temperature; at first warmer, afterwards very unseasonably cold, and throughout frequently stormy and rainy. The rest of the growing, as well as the early ripening period, was changeable, though for the most part unseasonably cold, cloudy, and sunless, with a great deal, and some very heavy falls, of rain, which much laid the crops. The harvest-time, though late, and including some heavy rains, was, however, upon the whole, not unfavourable for the greater portion of the Midland, Southern, and Eastern districts.

With a wet autumn, a winter alternately very mild and very severe, a spring with alternations of extreme heat with cold, frost, and wet, and a summer with a good deal of sunless weather, with occasional violent storms of wind and rain, much laying the crops, were not conditions from which a productive harvest might be expected. Yet, both before and after the favourable change at harvest time, some writers in the 'Times' gave very sanguine views of the crops of the country at large. The records in the agricultural papers were, however, much less favourable; and the results obtained at Rothamsted led to the conclusion that the general wheat-crop would be not less than 20 per cent. below an average. Subsequent experience showed that this unfavourable estimate was only too well founded. Spring crops were almost everywhere sown late, especially on heavy lands. Barley was said to have suffered a good deal from the frosts of May, but at harvest the crop was reported to be but little under average in quantity, though variable in quality. Oats were considered to be over average.

The experimental wheat crop was very deficient in straw, and, upon the whole, more deficient in quantity of corn than in any year since 1853; though the quality of the grain was even over average. The following results were obtained in the experimental barley-field:—

TABLE XVII.—Quantity and Quality of Barley on Selected Plots. Sixteenth Season, 1867.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bush.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	45⅝	54·8	2614	27⅛	5652	86·1
1 O	Unmanured	17⅛	51·8	978	10¼	2124	85·3
4 O	Mixed Mineral Manure ..	20⅞	53·6	1180	12	2526	87·7
1 A	200 lbs. Ammonia-salts ..	30⅝	51·3	1686	17¼	3611	87·6
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	43⅞	54·3	2454	25½	5304	86·1
4 A A	Mixed Mineral Manure, and 200 lbs. (1) Ammonia-salts	45	54·6	2573	28⅜	5753	80·9
4 C	Mixed Mineral Manure, and 1000 lbs. (2) Rape-cake ..	42⅝	54·8	2411	24¼	5121	89·0

(1) 400 lbs. the first 6 years (1852–7). (2) 2000 lbs. the first 6 years (1852-7).

Owing to the alternate wet and frost, and the consequent unworkable condition of the land, the experimental barley was again sown late, not being put in until April 5. The earlier plots were cut on August 20 and 21, the later not until August 27 and 28, and the whole were carted on August 31. The earlier and better crops, those grown by manures containing nitrogen and superphosphate, and by farmyard-manure, were the most laid. Notwithstanding this, owing to the improved weather at the final ripening, and harvest time, it was just these crops that gave a rather better than average weight per bushel of corn, whilst the poorer and more backward crops gave lower than the average weight per bushel. The quantity of both corn and straw was throughout lower than the average, and the deficiency was proportionally the greater the greater the relative deficiency of available nitrogen within the soil; that is to say, without manure, and with purely mineral manure. The proportion of corn to straw was generally not far from the average, and, under some of the best conditions of manuring, somewhat over the average. Upon the whole, therefore, the experimental barley crop was deficient in quantity, but of full average quality. The deficiency in the spring-sown crop was, however, much less than that of the experimental wheat; and less, perhaps, than might have been expected considering the late sowing, the alternations of forcing and checking conditions of weather during the earlier stages, and the sunless character of the later periods of growth. The result is, at the same time, consistent with that recorded of the barley-crop of the country, which, according to the more reliable authorities, suffered considerably less than wheat; it is also consistent in showing relatively less deficiency the better the soil-conditions.

Seventeenth Season, 1868.

October, 1867, was very variable as to temperature, upon the whole colder than usual, with comparatively little rain, but occasional high winds. There was very unusually little rain in November, and the weather was for the most part clear but cold, and very favourable for working the land and sowing. December was characterised by great and rapid variations of temperature and barometric pressure, some extremely heavy gales, sometimes frost, snow, and sleet, at others very warm weather; in the aggregate there was a full amount of rain, and throughout the month agricultural operations were much impeded. The first eleven days of January, 1868, were very cold; but from that time to the end of the quarter (indeed to the end of the summer), the weather was unusually warm. There was a considerable excess of rain, and there were several gales of wind, in January; but there were only moderate amounts of rain in February and March. In these months vegetation became very forward, and the weather was generally favourable for working the land and for spring sowing. April, May, and June, again, were all considerably warmer than the average. The average temperature of April had however frequently, and that of each of the other months occasionally, been exceeded in the corresponding months of other years; but the average temperature of the three months together had only once been exceeded in any corresponding three months for 98 years (the period for which records are available), namely, in 1865, when, though April was hotter, May and June were not quite so hot as in 1868; and the average temperature of the whole period, from the middle of January to the end of June, was only exceeded in 1822. Concurrently with this long-continued warm weather, there was, as already said, a great excess of rain in January, and only moderate amounts in February and March; there was a small excess in April, a deficiency in May, and a very great deficiency in June. Temperatures in excess of the average also prevailed almost continuously throughout the succeeding quarter, namely, to the end of September. July, in particular, was very excessively warm, with at the same time a continued great deficiency of rain; August was also warmer than the average, but with a good deal of rain; and September more in excess as to temperature than August, with a deficiency of rain. In no year of the previous 98 had the temperature so far exceeded the average in so long a corresponding period as that from the middle of January to the end of September of this year, 1868. The total rainfall of the nine months was not much below the average; but the amount which fell was very excessive in January, and excessive also in April and in August, whilst it was deficient in each of the other months of the period, and very greatly so during the three consecutive months of greatest heat, namely May, June, and July. The degree of humidity of the atmosphere was also lower than the average in each of the nine months from January to September inclusive, greatly so in June, very greatly so in July, and considerably in August and September.

The characters of this extraordinary season may be briefly summarised as follows:—After a favourable autumn seed-time, the first half of the winter was very variable, including some very warm, but more stormy, wet, snowy and frosty weather. From that time to after harvest, the temperature was almost always above the average, and very greatly so in the summer months of June and July; whilst, after a favourable spring seed-time, there was a sufficiency of rain in April to give a fair start to early-sown crops; but, from that time until the harvest was nearly over, throughout the Midland, Southern, and Eastern districts of the country, the excessive temperatures were accompanied by a drought of unusual severity, both as regards the length of its duration, and the great amount of the deficiency of rain, with at the same time a very dry atmosphere.

With the favourable autumn seed-time, the area under wheat was over average. In the spring the plant was generally good, the harvest was very early, and finally the crop was reported to be considerably over average in both quantity and quality on good and well farmed soils; on light and poorly farmed land, on the other hand, the crop suffered much from the heat and drought. Still, the aggregate wheat crop of the country was supposed to be about 20 per cent. over average in quantity, and of over average quality. Naturally, spring-sown crops suffered much more from the heat and drought than wheat. Barley was, however, said to yield well, and be of good quality, on deep and well-farmed lands, and when sown early, but to be very deficient when sown late, or on shallow soils; and to be so on many of the usually good barley lands. Oats suffered more than barley, and were almost universally reported to be under average, and in many cases a complete failure.

The produce in the experimental wheat field was, under all conditions of manuring, over average in quantity, but proportionally much more so with high than with low manuring. The weight per bushel of dressed corn ranged from 3 to 5 lbs. over the average. The quantity of straw was considerably below the average with low manuring, but average, or over average, with high manuring. The proportion of corn to straw was also generally over average, but proportionally the less so the higher the manuring and the greater the bulk of the crop. The following results were obtained in the experimental barley-field:—

TABLE XVIII.—Quantity and Quality of Barley on Selected Plots. Seventeenth Season, 1868.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bush.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	43⅝	57·1	2539	24½	5281	92·6
1 O	Unmanured	15⅝	54·3	873	11⅝	2173	67·2
4 O	Mixed Mineral Manure ..	17⅞	55·3	998	10⅛	2126	88·5
1 A	200 lbs. Ammonia-salts ..	20⅜	53·3	1136	12¼	2507	82·9
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	34⅝	55·6	1978	20⅞	4311	84·8
4 A A	Mixed Mineral Manure, and 275 lbs. Nitrate Soda (1) ..	45⅜	56·0	2586	25⅝	5454	90·2
4 C	Mixed Mineral Manure, and 1000 lbs. (2) Rape-cake ..	36¼	55·4	2051	21⅛	4414	86·8

(1) 400 lbs. Ammonia-salts the first 6 years (1852–7), 200 lbs. the next 10 years (1858–67); 275 lbs. Nitrate Soda, 1868, and since.

(2) 2000 lbs. the first 6 years (1852–7).

Unfortunately, the seed was not put in until March 20; and with, excepting in April, a great deficiency of rain from that time until harvest, and, at the same time, unusually high temperatures and dry atmosphere, the crop was, for the locality, very early cut, namely, on July 31, and it was carted on August 5. The deficiency of both corn and straw is throughout very considerable, but proportionally the greater the more defective the manuring. Thus, compared with the average of the twenty years in each case, the deficiency of total produce, corn and straw together, was with farmyard-manure only about one-tenth, with mixed mineral manure and ammonia-salts (4 A), and with mixed mineral manure and rape-cake, about one-fourth, but with mineral manure alone, or ammonia-salts alone, about one-third. Further, in these cases of the more defective manuring, and the more deficient total crop, the proportion of corn to straw is below the average, whilst, with the nitrogenous and mineral manure together, as well as with farmyard-manure, the proportion of corn to straw is rather higher than the average. Deficient as was the quantity, the quality was, however, in all cases high; and the higher the more liberal the conditions of manuring. Thus, the weight per bushel was between 55 and 56 lbs. with the mixed mineral manure and ammonia-salts, and with the mixed mineral manure and rape-cake, and was over 57 lbs. with farmyard-manure.

It will be borne in mind that, during the first six years of the twenty (1852-1857), plot 4 A A had annually twice as much ammonia-salts as 4 A, but that, during the next ten years (1858-1867), only the same quantity of ammonia-salts was applied as on 4 A, namely, 200 lbs. per acre per annum; and reference to the tables will show that there has continued to be some excess of produce on 4 A A, as compared with 4 A, due to the unexhausted residue from the excessive supply during the first six years. For the year 1868, and subsequently, however, an amount of nitrate of soda, containing the same quantity of nitrogen, has annually been substituted on plot 4 A A for the 200 lbs. of ammonia-salts applied during the previous ten years; and it will be seen that, in this year of drought, the plot with the nitrate gives nearly 11 bushels more corn, and about 5 cwts. more straw, than the plot with an equivalent quantity of nitrogen as ammonia-salts. This amount of excess is much greater than has been obtained in any succeeding year hitherto; though in 1870, which was also a year of drought, the excess of produce with the nitrate was again very considerable.

In a paper in a former volume of this Journal,* we showed that the soil of the plot in the experimental wheat-field which

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* Vol. vii.—s.s. Part I.—"Effects of the Drought of 1870 on some of the Experimental Crops at Rothamsted."

had then been manured with 14 tons of farmyard-manure per acre per annum for twenty-five years in succession, owing to its vast accumulation of organic matter, and greater degree of disintegration, porosity, and power of absorption, retained, near the surface, very much more water than that of either the closely-adjoining unmanured, or an artificially manured plot in the same field.

In the same paper we recorded the fact, that a plot of permanent meadow-land which received annually mixed mineral manure, and a given amount of nitrogen as ammonia-salts, yielded in the season of drought of 1870, 23 cwts. of hay less than its average; whilst, another plot, receiving annually the same mineral manures, and the same amount of nitrogen, but in the form of nitrate of soda instead of ammonia-salts, yielded, in the same season of drought, only 1¼ cwt. of hay less than its average amount, and about 26¾ cwts. more than the plot manured with the same mineral manure and the same amount of nitrogen as ammonia-salts.

This result was assumed to be connected with the difference in the character of the two nitrogenous manures (ammonia-salts and nitrate of soda), in regard to their reactions upon the soil, and the consequent degree of rapidity and range of distribution of them, or their products of decomposition, within it;—the nitrate, or its products of decomposition, becoming much more rapidly distributed, and washed into the subsoil, whither the roots follow it. On examination it was found —that certain plants of the mixed herbage, having roots of a characteristically downward tendency, were much more prevalent on the plot manured with nitrate of soda, than on that manured with ammonia-salts; that the subsoil of the nitrated plot was disintegrated and permeated by roots to a much greater depth; and that, accordingly, the lower layers of the subsoil had been pumped much drier by the action of roots, than the corresponding layers of the plot manured with ammonia-salts.

These very interesting and significant facts point to the explanation of the much less prejudicial influence of the drought of 1868 on the experimental barley-crops grown by farmyard-manure, and by mineral manure and nitrate of soda, than on those grown by mineral manure and ammonia-salts. In the case of the farmyard-manure plot, the result was probably due to the great amount of moisture taken up, and retained, by the upper layers of the soil, from the winter and early-spring rains. In that of the nitrated plot it was, it is true, the first year of the application; but, with the fair amount of rain in March, and the full amount in April, it is still probable that there would be a considerable distribution of the manure, and, accordingly, an increased disintegration, and porosity of the subsoil, and retention of moisture by it; the combined conditions leading to a correspondingly greater distribution of the roots in the lower layers, by virtue of which the plants would obtain possession of a greater range of soil, and an increased supply of moisture within it. In the one case, therefore, it was the resources of moisture in the upper layers of the soil, and in the other those in the lower layers, that rendered the growing crop more independent of the supplies from external sources.

In conclusion, the difference of effect of the excessive summer heat and drought on winter and spring-sown crops, and on crops grown on deep and on shallow soils, was very striking. Thus, the experimental wheat-crop indicated a produce about 20 per cent. over the average, and the wheat-crop of the country at large was extremely good on good soils, though very poor on poor soils, yet was supposed to yield in the aggregate 20 per cent. over an average. The rather late-sown experimental barley, on the other hand, gave a produce from one-tenth to one-third below the average, according to the manure employed; and the barley-crop of the country was good when sown early on deep soils, and very deficient when sown late on shallow soils, but gave in the aggregate a considerably deficient crop. The great protection against the injurious effects of summer drought, which the early sowing of spring-crops gives, by enabling the plant to obtain possession of a more extended root-range, was thus, in this season, strikingly illustrated.

Eighteenth Season, 1869.

The extraordinarily warm period of nearly nine months' duration ended with September, 1868. October and November were throughout, with very few exceptions, colder than usual, both day and night; whilst in October there was a deficiency of rain, and in November a very great deficiency. December, on the other hand, was almost throughout very much warmer than the average, with a very great excess of rain, some violent gales of wind, very variable, but, upon the whole, very low barometric pressures, and high degree of humidity of the atmosphere. The average temperature of December had, indeed, been exceeded only twice during the preceding ninety-eight years; namely, in 1806 and 1852. With the exception of a week after the middle of January (1869), the very warm period continued until the end of February, completing three winter months of average temperature about 6 degrees higher than the average of ninety-eight years. There was, again, considerable excess of rain in January, and a slight excess in February. March, on the contrary, was several degrees colder than the average, with about, or less than, the average amount of rain. Early in April warm weather set in, and lasted till nearly the end of the month, the temperature during this period being several degrees higher than the average, whilst the fall of rain was generally under the average. May and June were, with few exceptions, of short duration, very much colder than the average. Towards the end of May the cold was very extreme for the season, and the greater part of June was very unusually cold, both day and night; and in May there was a considerable excess, though in June a deficiency, of rain. Early in July there was again a change to warm weather, which lasted till the end of the month, during which there was very little rain. The first three weeks of August were very unseasonably cold and showery, though the total amount of rain was comparatively small; but the concluding week of the month was very bright and hot. Then came a short period of cold weather, but the remainder of September was warm but stormy, with a good deal of rain. In April, May, and June, the degree of humidity of the air ranged high, especially in May; in July it was about the average, but in August and September it was below it.

To sum up the characters of the season: The heat and drought of the spring and summer of 1868 were followed by a warm and dry September, but cold and dry October and November, providing a good autumn seed-time. The three winter months were very warm, and, December and January especially, very wet, bringing autumn-sown crops very rapidly forward, and providing an unusual amount of winter grazing, which greatly compensated for the previous deficiency. But, owing to the condition of the land, spring sowing was retarded. The weather in March was dry and cold, much checking vegetation; which, however, recovered rapidly under the influence of very warm, though somewhat dry, weather in April; but the remainder of the spring was very cold, and also wet; June, again, for the most part cold; July warm, most of August cold, the conclusion, and September, hot; whilst the summer was comparatively dry, though the harvest-time somewhat unsettled.

With a season characterised by alternate periods of forcing and checking weather, with more of the latter than of the former during the time of most active growth, and with a changeable ripening and harvest period, favourable or unfavourable for the crops according to their forwardness at the time, the reports of the crops of the country generally were very conflicting. The wheat-crop, though very variable, was reported to be, in the aggregate, somewhat below an average, both in quantity and quality. The barley-crop was also very variable, but, perhaps, upon the whole rather better than wheat. Oats were more uniformly bad.

In accordance with the characters of the crop of the country, the experimental wheat-crop was very variable; much below the average under most conditions of manuring, but above it under others; and particularly so with farmyard-manure, and the mixture of mineral manure and nitrate of soda—a point to which further reference will be made presently. The results in the experimental barley-field were as follows:—

TABLE XIX.—Quantity and Quality of Barley on Selected Plots. Eighteenth Season, 1869.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn. Quantity.	Dressed Corn. Weight per Bush.	Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	46⅞	56·4	2746	28⅝	5959	85·5
1 O	Unmanured	15⅛	52·4	840	11	2075	68·0
4 O	Mixed Mineral Manure ..	22¼	54·6	1286	12⅞	2729	89·2
1 A	200 lbs. Ammonia-salts ..	27⅞	52·4	1599	18¼	3640	78·4
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	49¼	57·4	2848	34⅜	6701	73·9
4 A A	Mixed Mineral Manure, and 275 lbs. Nitrate Soda (¹)	49⅞	57·1	2929	38⅛	7194	68·7
4 C	Mixed Mineral Manure, and 1000 lbs. (²) Rape-cake ..	52⅛	57·4	3065	35⅛	7001	77·9

(¹) 400 lbs. Ammonia-salts the first 6 years (1852–7), 200 lbs. the next 10 years (1858–67); 275 lbs. Nitrate Soda, 1868, and since.
(²) 2000 lbs. the first 6 years (1852–7).

The seed was sown on March 13th; the earlier crops were cut on August 5th, and carted on August 16th; and the later cut on August 19th, and carted on August 25th. Between cutting and carting there was some cold and showery weather; but notwithstanding the later crops (those not manured with superphosphate) had the benefit of much hotter and drier weather before being carried, than the earlier (which were manured with superphosphate), the latter gave by far the higher weight per bushel; considerably higher indeed than the average. Unlike the wheat, the experimental barley gave, under liberal manuring, very generally more, both corn and straw, than the average; but without manure, with mineral manure alone, and with ammonia-salts alone, the produce, more especially of corn, was considerably below the average. The crop was, upon the whole, bulky, being heavy in straw; so that even where the produce of corn was more than the average, the proportion of corn to straw was less than the average.

After an unusually wet winter, the soil and subsoil would, doubtless, retain a good deal of moisture at seed-time, and, although March was cold and dry, April was warm and forcing, May was cold and wet, and June also cold; so that the characters of the season were obviously such as would tend to bulk, rather than to seeding tendency. In the case of the barley such was the result, but in that of the wheat the straw was proportionally more deficient than the corn. Again, with barley, there was more than average produce, both corn and straw, with mixed mineral manure and a given amount of nitrogen, whether supplied as ammonia-salts or as nitrate of soda; whereas, with wheat, there was a deficiency of both corn and straw with mineral manure and ammonia-salts, but an excess of both with the same mineral manure and the same amount of nitrogen supplied as nitrate of soda. It will be useful to try and trace the explanation of these differences.

It will be remembered that, in the season of drought of 1868, the experimental wheat-field gave much more, whilst the experimental barley-field gave much less, than average produce. In 1869, however, after a very wet winter, and, for the most part, cold weather at the periods of most active growth, the experimental wheat-field gave generally much less, whilst the barley-field yielded considerably more than the average. Doubtless, the advantage which the wheat had over the barley in the year of drought was due to its having obtained possession of a considerable range of soil before the drought commenced, and being thereby rendered less dependent than the spring-sown barley on the rain actually falling during the periods of active growth. The failure of the wheat as compared with the barley in 1869, after the very wet winter, was probably due, in great measure, to the washing out and loss by drainage of the nitrogen of the ammonia-salts sown in its case in the autumn; whereas, for the barley, the manures were not sown until the spring. A corroboration of this view is the fact that, though there was so considerable a deficiency in the produce of wheat with mixed mineral manure and a given amount of nitrogen supplied in the form of ammonia-salts sown in the autumn, there was no deficiency, but an excess of produce, of that crop, where the same mineral manures and the same amount of nitrogen were supplied, but the latter in the form of nitrate of soda, and applied not before the winter rains, but in the spring.

In a paper already referred to,* we have pointed out how very serious may be the loss of nitrogen by drainage, when ammonia-salts or nitrates are liberally applied in the autumn, and there is

* Vol. vii.—s.s. Part I.

much wet weather during the winter; or even when sown in the spring, if very heavy falls of rain should follow. Not only, however, is the rain of the spring and summer generally less continuous than that of the winter, but, as the season advances, the soil itself is usually in a drier state, there is more evaporation from it, and considerably more also from vegetation, tending to lessen the proportion of the rain passing below the reach of the roots, and carrying with it fertilizing matters. For important data relating to this subject we would refer to a paper by Professor Voelcker.* Some of the results he records we shall quote further on (Section IV.); but it may be useful to give here a single paragraph from our own paper above referred to.

"Fortunately, some of the most important mineral constituents of soils and manures are, in the case of the heavier soils at any rate, almost wholly retained by them within the range of the roots of our crops. Nitrogen, whether supplied in the form of ammonia-salts or nitrates is, however, much less completely so retained; being, in whichever state supplied, carried off in greater or less quantity in the drainage-water, chiefly in the form of nitrates. According to results obtained independently by Professor Frankland and Professor Voelcker, on the analysis of drainage-water from the experimental wheat-field at Rothamsted, that collected during the winter, from land manured in the autumn by an amount of ammonia-salts supplying 82 lbs. of nitrogen per acre, may contain from 2·5 to 3 parts, or even more, of nitrogen, as nitrates and nitrites, per 100,000 parts of water. Assuming that only 2·5 parts of nitrogen were so carried beyond the reach of roots for every 100,000 parts of water passing downwards, there would still be, for every inch of rain so passing, a loss per acre of between 5 and 6 lbs. of nitrogen, supplied in manure at a cost of not much less than 1*s.* per lb."

Now, in December, January, and February, 1868-9, about 10·5 inches of rain fell, being about 4·5 inches more than the average; and although data are at present wanting for anything like an accurate estimate of what proportion of this large amount of rain would pass away by drainage,† it may at any rate be concluded that several inches would do so. It can hardly be wondered at, therefore, that, in the case of the wheat, the plots receiving nitrogen as ammonia-salts in the autumn were much less productive than usual, and also, in a much greater degree than usual, deficient compared with the plot receiving its nitrogen as

* "On the Productive Powers of soils in relation to the loss of Plant-Food by Drainage." By Professor Voelcker, Ph.D., F.R.S. ('Jour. Chem. Soc. Lond.,' June, 1871.)

† See evidence on this point in the paper in this Journal before referred to. Vol. vii.—s.s. Part I.

nitrate of soda applied in the spring.* It is intelligible, too, that the barley, the whole of the manures for which were applied in the spring, should, equally with the wheat-plot which received

* During the early years of the comparative trials, a given amount of nitrogen, applied as ammonia-salts in the autumn, gave more produce of wheat, both corn and straw, than an equal quantity applied in the spring as nitrate of soda; but during the last 12 or 14 years the nitrate of soda, applied in the spring, has given more produce than the ammonia-salts applied in the autumn.

The years in which the nitrate showed specially great superiority over the ammonia-salts, due rather to deficiency of produce by the latter, than to any considerable excess over the average by the former, were 1860, 1867, 1869, and 1871. In 1860 the produce by ammonia-salts was very much less than the average, and by the nitrate slightly under the average, though much above the ammonia-salts; and the records show that there had been an excess of rain in November, December, and January, and again in March, April, May, and June. In 1867 there was a greater deficiency of total produce by the ammonia-salts than in any other year, a small deficiency even by the nitrate, and very great deficiency by the ammonia-salts compared with the nitrate; and there had been a greater or less excess of rain in almost every month from seed-time to harvest, namely, in November, December, January, February, March, April, May, and July. In 1869 there was a considerable deficiency by the ammonia-salts, but less than in 1860 or 1867; and by the nitrate a small excess over its average, and a great excess over the ammonia-salts; and there had been a considerable deficiency of rain in November, but a very considerable excess in December, January, and February, a slight excess in April, and a greater excess in May, but very dry weather afterwards until harvest. Lastly, in 1871, there was a very considerable deficiency by the ammonia-salts, a slight excess by the nitrate, and very great excess by it as compared with the ammonia-salts; there was an excess of rain in December and February, and a great excess in April, June, and July.

There was also considerable excess by the nitrate compared with the ammonia-salts in 1862, in 1866, and in 1868. But in these cases, especially in 1862 and 1868, the result was, for the most part, due to over average produce by the nitrate, and but little, if at all, to under average by the ammonia-salts. Accordingly, in 1861–2, after a considerable deficiency of rain in the three preceding months, there was a considerable excess in November, but again a deficiency in December, January, and February, and then a considerable excess in March, April, May, and June—that is after the nitrate had been applied, but after active vegetation had commenced. Again, in 1868, with a deficiency of rain in each of the four preceding months there was a slight excess in December, considerable excess in January, slight excess in February, March, and April, but very great deficiency afterwards until harvest.

These examples, though differing much from one another in many points, nevertheless sufficiently clearly point to the conclusion that, in the first series of years enumerated, the considerable difference between the amount of produce by the ammonia-salts applied in the autumn, and the nitrate of soda applied in the spring, was due to deficient produce by the former resulting from a washing out of its nitrogen by the winter rains; whilst, in the other instances, it was due to the greater effectiveness of the nitrate under the influence of the conditions of the season after the commencement of active growth, which were widely different in the two cases more specially noticed; giving, in 1862, with a comparatively wet and cold spring and early summer, a greater excess of straw, and in 1868, with very hot and dry weather during the most active period of growth, a greater excess of corn.

It will be understood that the above remarks are not supposed to give anything like a complete description of the characters and effects of the seasons referred to, but are only intended to illustrate the difference of effect of a given amount of nitrogen supplied as ammonia-salts in the autumn, and as nitrate of soda in the spring, dependent, in great measure, on the different degree of liability to loss by drainage in the two cases.

its nitrogen in the spring, give more than average total produce, and especially an excess of straw.

The very different results obtained with winter-sown and spring-sown crops, in the strikingly contrasted seasons of 1868 and 1869, thus illustrate very instructively the extremely varying effects of some of our most active manures, according to the time of their application, and to the characters of the season. Moreover, with the explanations given, it becomes the more intelligible that, in certain seasons, the accounts of the growing crops should be very conflicting for soils of different characters and in different conditions as to manuring. A consideration of the results obtained in the next season, 1870, which was one of even more prolonged drought than that of 1868, will be confirmatory of the explanations given of the results of that year, and will afford further opportunity for usefully directing attention to the points involved.

Nineteenth Season, 1870.

Until the middle of October the autumn of 1869 was for the most part warm, with a good deal of rain. From that time until the end of the year the weather, though including some rapid fluctuations, some very warm days, and a warm period of more than a week in the middle of December, was otherwise very cold and inclement, and especially wintry towards the end of October; there were numerous gales throughout the quarter; but there was less rain than usual in October, about the average in November, and a considerable excess in December. The falls were heavy and continuous at the end of November, and again in the middle of December; and the drains in the experimental wheat-field ran frequently from November 28th, 1869, to January 1st, 1870. The first three months of 1870 were characterised by frequent alternations of warm and very cold weather—the colder periods being, however, much the longer, and sometimes very severe; snow was very frequent, but the rain-gauge indicated a deficient fall in January, in some localities a deficiency in February, but a very heavy fall early in the month, and an excess in March. From early in April to near the end of the month the weather was very warm and dry; then followed about a fortnight of cold and cloudy weather, from which time until nearly the end of June it was again very warm, sunny, and dry—the three months together being not only warmer than the average, but very unusually deficient in rain. The day-temperatures especially were high, though the night-temperatures were in April and May low, but in June high. The end of June and the beginning of July were cold and variable, but the remainder—indeed, nearly the whole of July, as well as the first half of August—were very warm. Then, to the end of September, a period of about six weeks, the temperatures were pretty uniformly below the average, though the weather continued fine. Thus, the period of drought, which had commenced with April, continued to nearly the end of August, and even in September there was less than the average fall of rain. The great deficiency of rain throughout five consecutive months was, moreover, accompanied by great dryness of atmosphere—the degree of humidity of the air being in April very unusually low, and in May, June, July, and August, also considerably below the average.

The autumn of 1869, though, as the details show, frequently cold, boisterous, and inclement, was, upon the whole, not unfavourable for getting in the seed. The winter, though changeable, included a great deal of very cold weather. In the early spring both field-work and vegetation were very backward, and at the end of April grass-land was very brown and bare. From the beginning of April until harvest the weather was, with few exceptions, of short duration, warmer than usual, with a great deficiency of rain and a very dry atmosphere.

The combined heat and drought were even more extreme during the months of May, June, and July, 1868, than during the corresponding months in 1870; but in the latter year the deficiency of rain commenced a month earlier, and continued later than in 1868. Hence, the grass crops suffered the more, indeed very excessively, in 1870; and, for a parallel, we must go back as far as 1844. As in the two preceding years (1868 and 1869), the reports of the cereal crops of the country were very variable, but for very opposite reasons in the years of heat and drought, 1868 and 1870, as compared with 1869. In 1870, the year now under consideration, the wheat plant suffered much before the active growing time began—in some cases from wire-worm, and in others from frosts; in not a few instances it was ploughed up and spring-corn sown; whilst, over large areas, the remaining plant was said to be very thin on the ground, and there was very much more than usual difference in the character of the crops in adjoining fields. Still, the best wheat lands were said to carry, though not a bulky, yet a very good yielding crop, and to give grain of very high weight per bushel. Estimates of the aggregate yield for the most part put it, if not under, at scarcely over an average; but the annual report from Rothamsted (though admitting that the country had probably produced some of the lightest as well as some of the best crops ever known) laid it at rather over average. Barley was also very variable. The seed had for the most part been got in well, and, where sown early and in deep soils, was good; but when sown late, and in light soils, it had suffered very much from the drought. Oats were also generally well got in; but, besides injury from wire-worm, they had suffered from the heat and drought more than either wheat or barley, and gave, upon the whole, a very light crop throughout Midland, Eastern, and Southern districts.

The experimental wheat-field gave, under all conditions of manuring, considerably less than the average produce of straw; but, without manure, and with farmyard-manure, about the average, and with liberal artificial manuring (mineral manure and ammonia-salts or nitrate of soda) considerably more than the average quantity of corn. Under all conditions the weight per bushel was much over the average; in fact, generally, though not uniformly, as high as in any preceding year. The following results were obtained in the experimental barley-field:—

TABLE XX.—Quantity and Quality of Barley on Selected Plots. Nineteenth Season, 1870.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bush.				
		Bushels.	lbs.	lbs.	Cwts.	lbs	
7	14 Tons Farm-yard Manure	47½	57·1	2734	19¾	4950	123·4
1 O	Unmanured	13½	52·9	751	6⅝	1489	101·8
4 O	Mixed Mineral Manure ..	18½	55·6	1053	9⅜	2101	100·5
1 A	200 lbs. Ammonia-salts ..	27¾	54·6	1539	12½	2945	109·4
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	38	57·1	2197	18⅝	4287	105·1
4 A A	Mixed Mineral Manure, and 275 lbs. Nitrate Soda ([1])	44½	57·1	2571	18¼	4621	125·4
4 C	Mixed Mineral Manure, and 1000 lbs. ([2]) Rape-cake ..	43¾	58·0	2569	20⅜	4857	112·3

([1]) 400 lbs. Ammonia-salts the first 6 years (1852–7), 200 lbs. the next 10 years (1858–67); 275 lbs. Nitrate Soda, 1868, and since.
([2]) 2000 lbs. the first 6 years (1852–7).

The seed was sown on March 15; the usually earliest plots were cut on July 27, and carted on August 5; and the remainder were cut on August 8, and carted on August 12. With a very unusually deficient rain-fall from the date of sowing until harvest, and also a great deal of hot weather, the amount of total produce (corn and straw together) was, as might be expected, very much below the average; and the deficiency of straw was throughout greater than that of corn. Without manure, and with mineral manure alone, the produce of corn was only two-thirds the average, and that of straw even less, especially without manure. In most other cases the produce of straw was only about two-thirds the average, whilst that of corn ranged from five-sixths of the average to nearly average. As in 1868, the deficiency of corn was much less with farmyard-manure, and with mineral manure and nitrate of soda, than with mineral manure and ammonia-salts. In 1870 it was also considerably less with mineral manure and rape-cake. The proportion of corn to straw was, under all conditions of manuring, very high, and under some higher than in any other year of the twenty. It was the highest, indeed very unusually high, with farmyard-manure, with rape-cake, and with mixed mineral manure and nitrate of soda. The only years approaching 1870 in proportion of corn to straw were 1857 and 1865, both of which had, however, considerably the advantage in actual quantity of corn per acre. The quality of the grain, as indicated by the weight per bushel, was throughout considerably higher than the average, and under some of the most liberal conditions of manuring it was as high as, or higher than, in any other year.

Thus, with a drought of extraordinary severity, extending through the whole period of active growth and ripening, accompanied for the most part with higher temperatures than usual, and a very dry atmosphere, the experimental wheat-field gave considerably less straw, but with high artificial manuring considerably more corn, than the average, and grain of very high quality. The spring-sown barley, on the other hand, gave a crop deficient in both straw and corn; very deficient in straw, and very deficient in corn also with defective manuring, though much less so with high manuring; and, like the wheat, it gave grain of very high quality. The greater power of the winter-sown crop to withstand spring and summer drought and heat, provided the subsoil be moderately retentive, is here again illustrated.

Compared with 1868, which was considerably hotter during May, June, and July, but not deficient in rain in April or August as well as the intermediate months as was 1870, the experimental wheat-field gave, in 1870, very much less straw than in 1868, but under liberal artificial manuring about, or nearly, as much corn. The experimental barley-field, on the other hand, gave under some conditions of manuring more, but, upon the whole, less straw, though, under high manuring, more corn in 1870 than in 1868. In fact, owing to the greater heat, the soil was probably deprived of its moisture to a greater degree by the shorter drought of 1868 than by the longer one of 1870, and hence the less productiveness of the spring-sown crop in the former than in the latter year.

When speaking of the crop of 1868, attention was called to the fact that the farmyard-manure plot, and the one receiving mixed mineral manure and nitrate of soda, suffered much less from the drought than that receiving mixed mineral manure and ammonia salts. In 1870 the general character of the results was, as already intimated, very similar. Under each of the conditions mentioned, the deficiency of straw was, it is true, considerably greater in 1870 than in 1868; due, doubtless, to the much less rain in April; but the produce of corn was, with farmyard-manure considerably higher than, and with mixed mineral manure and nitrate of soda nearly as high as, in 1868; indeed, with farmyard-manure, it was very nearly average, and with the nitrate, as in 1868, very much higher than by mixed mineral manure and the same amount of nitrogen supplied as ammonia salts—though, as the produce by the ammonia salts was not so defective in 1870 as in 1868, neither was the excess by the nitrate so great as then. There can be little doubt that, the greater porosity of the soil, and the consequently greater power of absorption and retention of moisture near the surface, where the dung was applied, and the greater disintegration and porosity of the subsoil, and the more extended distribution of the manure and of the roots within it, where the nitrate was used, had again enabled the growing crops the better to withstand the heat and drought.

To sum up: The extraordinarily prolonged season of drought of 1870, though yielding, as might be expected, small amounts of total produce (corn and straw together), of both wheat and barley, but especially of the spring-sown crop, was remarkable for giving, of wheat grain even an excess, and of barley grain much less deficiency, the higher the manuring; much less deficiency with farmyard-manure, and with nitrate of soda, than with ammonia-salts; and, with both crops, very high proportion of corn to straw, and very high weight per bushel of corn.

Twentieth Season, 1871.

In October, 1870, the changes of temperature were very frequent, giving, however, about the average for the month; and there was a slight excess of rain. The first 19 days of November were for the most part cold, the remainder warm, but the average for the month was low, and there was a considerable deficiency of rain. There were about 10 days of very warm weather in the middle of December, but the beginning and end of the month were cold; the latter extremely so, with a good deal of snow and cold wind; the average for the month was 5 or 6 degrees below the average for 99 years; and the rain, and melted snow, indicated a considerable excess of fall. January, 1871, with the exception of a few days in the middle of the month, was cold; and at the beginning, and for nearly a fortnight at the end, the weather was extremely severe. From early in February, until the middle of March, the weather was very mild, and thence to the end of the month the temperatures were very variable. There was a full amount of rain (or snow) in January, but a deficiency in both February and March; though the melting of the snows of January, succeeded by frequent rains early in February, caused floods in many parts. April, May, and June were, with the exception of the latter half of April, which was warm with a good deal of south-west wind and rain, unusually cold, with a great deal of east or north wind, or some compound of the two; and there was an excess of rain in April and June, but a deficiency in May; June, especially, being very unseasonably cold and wet. July, excepting about a week after the middle of the month, was cold, with a considerable excess of rain; but, from early in August to about the middle of September, there was a period of 6 weeks of warm and genial weather, from which time, till the end of September, it was again very cold, wet, and stormy. August was not only warm, but there was very little rain, whilst in September there was, towards the end of the month, a great excess of rain. The degree of humidity of the air was high in April and June, rather high in July, rather low in May, very low in August, and low in September.

The autumn of 1870 was thus changeable as to temperature, upon the whole cold, wet during the first half of September, and also of October, but afterwards comparatively dry and favourable for field work. The greater part of the winter was extremely severe, with a good deal of snow, and very cold winds; the remainder was mild and very wet, retarding field work and spring sowing; whilst winter corn was very backward, in many cases injured, pastures very bare, and vegetables very scarce. The hard winter had, however, killed many insects, and March was favourable for field work and sowing. With the exception of the latter half of April, the remainder of the spring was cold and backward. The rest of the active growing period was, excepting one or two intervals of short duration, cold, bleak, and very wet; hay was much damaged, corn crops were very backward, and in many cases much laid. In the greater part of England, however, August and the early part of September were warm and dry, much aiding the ripening and getting in of the crops; but the latter half of September was cold and wet.

With a very severe winter, a cold spring, more than the first half of the summer also cold, and a great excess of rain in June and July, the reports of the wheat crop of the country were, with few exceptions, unfavourable. The seed had mostly been got in well, but with a winter of intense frosts, and high east winds sweeping the snow which fell into the furrows, hollows, and hedges, much wheat was killed or injured. A good deal was ploughed up, some re-sown in the spring; the heavy soils suffered most, and the crops were much laid in July; but the ripening and harvest periods were more favourable. Still, the crop was estimated at much below the average in quantity, and considerably, though less, below the average in quality. Owing to the drought of the previous summer, and the frosts of the winter, the land was in a very healthy condition for spring-sowing; the weather was favourable in March, and spring crops were generally well got in. Barley was throughout the early portions of the season generally pronounced to promise well. Later, the heavier crops were a good deal laid; but at harvest the aggregate crop was concluded to be considerably over the average in quantity, and, for the most part, of fair, or even of good quality. Oats, on the other hand, were more generally less promising; injury from wire-worm was not unfrequent, and eventually the crop was estimated at under average.

In the experimental wheat-field the produce of both corn and straw was, by farmyard-manure, notably above the average of 28 years; but, without manure, and under nearly all conditions of artificial manuring, it was in a greater degree below the average, and proportionally more deficient in corn than in straw. The exception was the plot with mineral manure and nitrate of soda, which gave more than the average produce of straw, and proportionally less deficiency of corn, than the other artificial manures. The weight per bushel of corn was also considerably below the average in all cases excepting with farmyard-manure and the mixture of mineral manure and nitrate of soda. The following results were obtained in the experimental barley field:—

TABLE XXI.—Quantity and Quality of Barley on Selected Plots. Twentieth Season, 1871.

Plots.	MANURES, PER ACRE.	PRODUCE PER ACRE, &c.					
		Dressed Corn.		Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.
		Quantity.	Weight per Bush.				
		Bushels.	lbs.	lbs.	Cwts.	lbs.	
7	14 Tons Farm-yard Manure	$54\frac{1}{4}$	56·6	3243	$37\frac{1}{8}$	7401	78·0
1 O	Unmanured	$16\frac{3}{4}$	55·0	973	11	2208	78·8
4 O	Mixed Mineral Manure ..	25	55·6	1438	14	3002	92·0
1 A	200 lbs. Ammonia-salts ..	$36\frac{3}{8}$	55·6	2129	$23\frac{1}{8}$	4712	82·5
4 A	Mixed Mineral Manure, and 200 lbs. Ammonia-salts ..	$46\frac{1}{2}$	56·5	2769	$32\frac{1}{2}$	6404	76·2
4 A A	Mixed Mineral Manure, and 275 lbs. Nitrate Soda (1)	46	56·3	2683	$32\frac{5}{8}$	6333	73·5
4 C	Mixed Mineral Manure, and 1000 lbs. (2) Rape-cake ..	$47\frac{1}{2}$	56·4	2809	32	6394	78·4

(1) 400 lbs. Ammonia-salts the first 6 years (1852–7), 200 lbs. the next 10 years (1858–67); 275 lbs. Nitrate Soda, 1868, and since.
(2) 2000 lbs. the first 6 years (1852–7).

The seed was sown on March 4; the more forward plots, which this season were only those manured with nitrate of soda and phosphates, and those with rape-cake, were cut on August 11 and 12, and carted on August 16; the remainder, indeed the majority, were cut on August 14 and 15, and carted on August 21. With nearly the whole of the active growing period cold and very wet, the crops of this, the twentieth season in succession of the growth of barley on the same land, were, under nearly all conditions of high manuring, more bulky than usual, but many of them were much laid. The excess of straw, compared with the average, was especially great with farmyard-manure. The proportion of corn to straw was in all cases below the average. But, with much improved weather at the ripening and harvest time, the actual quantity of corn per acre was, under most conditions of high manuring, and especially with farmyard-manure, above the average; and the weight per bushel of dressed corn was, under all conditions without exception, above the average.

When speaking of the results obtained in the barley-field in the two years of summer drought, 1868 and 1870, particular attention was called to the fact that the plots manured with farmyard-manure, or with nitrate of soda, withstood the drought much better than those manured with ammonia-salts. After the wet and cold spring and summer of 1871, the farmyard-manure still gave very high total produce—indeed as high as in any year of the twenty excepting 1864; as heavy a weight of straw as in any year excepting 1864 and 1854; and as much corn as in any year excepting 1864 and 1863. But the nitrate-of-soda plots, though giving more corn, and considerably more straw, than in either of the years of drought, did not in this wet and cold season show the same superiority over the plots manured with ammonia-salts that they did in either 1868 or 1870. The nitrated plot—the results of which are quoted in the Tables (4 A A)—being one of the ripest in the field, suffered, it is true, considerably by the depredations of birds; but, independently of this, there is evidence enough that the nitrate did not show the same superiority over the ammonia-salts in the cold and wet as in the hot and dry season. Something may be due to the greater exhaustion of the nitrated plots in the preceding years of drought; but something is, doubtless, also due to more loss by drainage of the nitrogen of the spring-sown nitrate, than of that of the also spring-sown ammonia-salts, during the wet summer of 1871.

In connection with the fact, and the explanation, of the comparatively defective result with the nitrate in a wet summer when applied to barley, the very opposite result with wheat is of considerable interest. Thus, as already mentioned, there was, in the experimental wheat-field, much less deficiency of corn, and even an excess of straw, by the nitrate, as compared with the ammonia-salts. The explanation of the difference of effect with the two crops would seem to be, that whilst for the wheat the nitrate was not sown until the spring, the ammonia-salts had been sown in the previous autumn, and were subject to a considerable loss by drainage during several extremely wet periods of the winter, when there was no growth, and before the nitrate was sown. It will be remembered that a similar result was obtained with wheat after the wet winter of 1868-9; and also in other years, as referred to in the foot-note at p. 146.

Finally, it will be observed that the results obtained in the experimental fields are in the main in accord with the reports of the crops of the country at large, in showing a considerably deficient wheat-crop, and a barley-crop above the average both in quantity and quality, though the twentieth in succession on the same land.

Comparison of the Produce of Barley in the least, and in the most, productive Season of the Twenty.

The foregoing records of the characters of the seasons, and of the produce of barley in each individual year of the twenty, with the comments made upon them, very forcibly illustrate the diversity between one season and another, and how very varied is the final result, dependent on the mutual adaptations of heat, moisture, and stage of growth of the crops. In no two years has one and the same manure yielded precisely the same result both as to the quantity and the quality of its produce. Nor have the seasons which have been more or less favourable than the average for one description of manure, been equally favourable or unfavourable for other descriptions.

Referring to the previous discussion, and to the materials brought together in the Appendix-Tables (pp. 163—185), for any more detailed consideration of the subject, it must suffice here, by way of illustration and summary, to call special attention to the produce yielded by the same description and quantity of manure in the least, and in the most, productive season of the twenty.

Table XXII. (p. 156) shows, side by side, the quantity and quality of the produce obtained in 1854, which was upon the whole the most, and in 1856, which was upon the whole the least, productive of the twenty seasons; also the difference between the two. For the purposes of this illustration, the same selection of plots has been made as in the foregoing consideration of the produce of each individual season. It is true that one or other of the descriptions of manure specified may have given more corn, or a higher weight per bushel, or more straw, in some other

TABLE XXII.—Quantity and Quality of Barley on Selected Plots, in the least, and in the most, productive Season of the twenty.

Plots.	MANURES, PER ACRE.	Least Productive Season, 1856.	Most Productive Season, 1854.	Difference over (or under –) 1856.
	Weight per Bushel of Dressed Corn.			
		lbs.	lbs.	lbs.
7	14 Tons Farm-yard Manure	47·1	53·9	6·8
1 O	Unmanured	49·1	53·6	4·5
4 O	Mixed Mineral Manure	47·0	54·0	7·0
1 A	200 lbs. Ammonia-salts	48·5	53·6	5·1
4 A	Mixed Min. Man., and 200 lbs. Ammonia-salts	46·4	54·3	7·9
4 A A	Mixed Min. Man., and 400 lbs. Ammonia-salts	45·4	52·1	6·7
4 C	Mixed Min. Man., and 2000 lbs. Rape-cake ..	46·3	52·8	6·5
	Total Corn per Acre, reckoned at 52 lbs. per Bushel.			
		Bushels.	Bushels.	Bushels.
7	14 Tons Farm-yard Manure	$31\frac{7}{8}$	$60\frac{1}{8}$	$28\frac{1}{4}$
1 O	Unmanured	$15\frac{5}{8}$	$37\frac{3}{4}$	$22\frac{1}{8}$
4 O	Mixed Mineral Manure	$19\frac{5}{8}$	$45\frac{5}{8}$	26
1 A	200 lbs. Ammonia-salts	$27\frac{1}{2}$	$53\frac{1}{8}$	$25\frac{5}{8}$
4 A	Mixed Min. Man., and 200 lbs. Ammonia-salts	$30\frac{3}{4}$	66	$35\frac{1}{4}$
4 A A	Mixed Min. Man., and 400 lbs. Ammonia-salts	$36\frac{1}{4}$	68	$31\frac{3}{4}$
4 C	Mixed Min. Man., and 2000 lbs. Rape-cake ..	$35\frac{3}{8}$	$65\frac{5}{8}$	$30\frac{1}{4}$
	Straw (and Chaff), per Acre.			
		Cwts.	Cwts.	Cwts.
7	14 Tons Farm-yard Manure	$19\frac{3}{4}$	$37\frac{1}{4}$	$17\frac{1}{2}$
1 O	Unmanured	$8\frac{3}{4}$	$21\frac{3}{4}$	13
4 O	Mixed Mineral Manure	$9\frac{3}{8}$	$23\frac{1}{8}$	$13\frac{3}{4}$
1 A	200 lbs. Ammonia-salts	$17\frac{1}{8}$	$30\frac{1}{4}$	$13\frac{1}{8}$
4 A	Mixed Min. Man., and 200 lbs. Ammonia-salts	$21\frac{1}{4}$	$40\frac{1}{2}$	$19\frac{1}{4}$
4 A A	Mixed Min. Man., and 400 lbs. Ammonia-salts	33	49	16
4 C	Mixed Min. Man., and 2000 lbs. Rape-cake ..	$30\frac{1}{2}$	$42\frac{1}{8}$	$11\frac{5}{8}$
	Total Produce (Corn and Straw), per Acre.			
		lbs.	lbs.	lbs.
7	14 Tons Farm-yard Manure	3866	7298	3432
1 O	Unmanured	1797	4405	2608
4 O	Mixed Mineral Manure	2075	4969	2894
1 A	200 lbs. Ammonia-salts	3347	6155	2808
4 A	Mixed Min. Man., and 200 lbs. Ammonia-salts	3981	7958	3977
4 A A	Mixed Min. Man., and 400 lbs. Ammonia-salts	5582	9026	3444
4 C	Mixed Min. Man., and 2000 lbs. Rape-cake ..	5257	8125	2868
	Corn to 100 Straw.			
7	14 Tons Farm-yard Manure	74·9	75·0	0·1
1 O	Unmanured	82·4	80·4	–2·0
4 O	Mixed Mineral Manure	96·3	91·5	–4·8
1 A	200 lbs. Ammonia-salts	74·8	81·5	6·7
4 A	Mixed Min. Man., and 200 lbs. Ammonia-salts	67·1	75·7	8·6
4 A A	Mixed Min. Man., and 400 lbs. Ammonia-salts	51·0	64·5	13·5
4 C	Mixed Min. Man., and 2000 lbs. Rape-cake ..	53·9	72·4	18·5

season than it did in 1854, or a worse result, on some point or other, than in 1856. But, looking chiefly to the results obtained under the best conditions of manuring, and the general characters of the produce, there can be no doubt that the seasons selected do, upon the whole, represent, respectively, the least, and the most, productive of the series.

In the first place, the weight per bushel of dressed corn was from $4\frac{1}{2}$ lbs. to nearly 8 lbs. less in the bad than in the good year, or from about $8\frac{1}{2}$ to nearly 15 per cent. less in the one case than in the other. Under almost every condition of manuring, 1856 was the worst season, so far as this point is concerned; but several other seasons gave higher weight per bushel than 1854.

It is obvious that, with a difference of from $8\frac{1}{2}$ to 15 per cent. in the weight of the bushel, a comparison of the actual number of bushels of dressed corn in the two seasons would much underrate the difference in the amount of produce, greatly to the disadvantage of the most productive one. Accordingly, the quantity of *total corn*, per acre, has, in each case, been calculated into bushels of the assumed uniform weight of 52 lbs. per bushel; and the results of this calculation are given in the second division of the Table.

There was, *without manure*, in the bad season about $15\frac{1}{2}$, in the good season $37\frac{3}{4}$ bushels of corn, or a difference of rather more than 22 bushels between the two; and also a difference in the quantity of straw amounting to 13 cwts. per acre.

With *farmyard-manure*, the unfavourable season of 1856 gave scarcely 32 bushels, whilst 1854 gave rather over 60 bushels, or a difference of $28\frac{1}{4}$ bushels of corn; and there was also a difference of $17\frac{1}{2}$ cwts. of straw.

Lastly, the three most productive artificial manures gave, respectively, in 1856, $30\frac{3}{4}$, $36\frac{1}{4}$, and $35\frac{3}{8}$ bushels of corn, and in 1854, 66, 68, and $65\frac{5}{8}$ bushels, or a difference in favour of the good year of $35\frac{1}{4}$, $31\frac{3}{4}$, and $30\frac{1}{4}$ bushels of corn, besides $19\frac{1}{4}$, 16, and $11\frac{5}{8}$ cwts. of straw.

Thus, with one and the same expenditure for manure, there was a difference in the quantity of produce obtained in the two seasons of from 30 to 35 bushels of corn, and in one case of nearly a ton of straw, or not much less than would represent the average barley-crop of many localities.

It is worthy of remark that, whilst the season of 1856 was far worse than that of 1853 as regards both the quantity and the quality of the barley-crop, 1853 was, for the experimental wheat (which that year could not be sown until the spring), in every particular worse than 1856. Again, whilst 1854 was a decidedly more productive barley-year than 1863, yielding under almost every condition of manuring not only more corn, but considerably more straw—in other words, a greater quantity of total produce, indicating greater luxuriance—1863 was, on the other hand, a considerably more productive wheat-year than 1854, and especially so in corn. Both years were, however, remarkable for very large produce of both corn and straw, of both wheat and barley.

The years next in order of productiveness, so far as the barley crop is concerned, were 1857 and 1864, which were very good wheat years also. But neither 1863, nor either of the two years last mentioned, yielded anything like the same amount of total crop, corn and straw together, as 1854. The years next in order to 1856 in point of badness of barley-crop were 1859, 1860, 1868, and 1870; the deficiency in the two last-mentioned years being due to summer heat and drought, but in the other two seasons to very opposite conditions.

The question arises—to what characters of season are the extreme differences of produce which have been traced to be attributed? Referring to the details already given respecting each individual season, so far as the other years above enumerated are concerned, it must suffice here to recall attention to the distinctive characters of the season of 1856 yielding the worst, and of 1854 yielding the best, barley-crop of the twenty years.

The very unusually productive season of 1854 had been preceded by a very severe winter; March and April were upon the whole warmer than usual, but May, June, July, and August were pretty uniformly below the average temperature; whilst in March, April, June, and July there was a very considerable deficiency of rain, though more than the average number of rainy days. In May, however, there was about double the usual amount of rain, and an unusually large number of rainy days. In August, again, there was a full amount of rain, which, however, fell for the most part in heavy showers, and the month was upon the whole favourable for ripening and harvest.

Thus, the season of 1854 was characterised by prevailing low rather than high temperatures, an abundance of rain at the period of early active growth (doubtless favouring root development), and again before harvest, but otherwise by dryness as well as coolness. It would seem, therefore, that the large produce was due to a sufficiency of moisture within the soil when most wanted, with, at other times, comparatively dry and temperate atmospheric conditions, resulting in a continuity of unchecked growth, rather than in very active luxuriance at intervals.

Compared, or rather contrasted, with the above climatic conditions, those of the extremely unfavourable season of 1856 were as follows:—

There had been some severe weather in the early part of the winter, but the later and greater part was upon the whole mild.

March, April, and especially May, were colder than the average, whilst June, July, and August, though showing average day-temperatures fully as high as usual, were very changeable, and in June and July the nights were cold. In each of the months of January, February, March, April, May, June, and July, there was considerably more rain than in the corresponding months of 1854—in all nearly 6 inches more; whilst, in April there was an excess over the average, in May more than double the average, and in August again an excess.

The season of 1856 was, therefore, characterised by a great excess of rain during the early periods of growth; considerably more than in 1854, and there was, besides, considerably more than in that year, both before and after that period. There were also, almost throughout, great fluctuations, and high ranges, of temperature. In other words, the season was very wet, with marked alternations of heat and cold, whilst it was, for the period of the year, the coldest during the time of the greatest excess of rain. Finally, there were heavy rains, with considerable fluctuations of temperature, about the ripening and harvest period. The very bad result in this season would seem to be due, therefore, to an excess of rain, with, at the same time, great alternations of temperature, during the most active periods of growth, entirely preventing continuity of progress; whilst the unhealthy plant thus produced was subjected to unfavourable maturing conditions.

The above description of the climatic conditions of the two seasons, as collated from meteorological records, will probably strike the reader as not showing so great a contrast as would be expected between the season of the greatest, and that of the least, productiveness of the twenty. Certainly 1854 was not marked by individual periods of more than ordinarily active luxuriance; the circumstances were rather those of steady and unbroken accumulation, followed by favourable maturing conditions. The extremely productive season of 1863 showed in this respect similar characteristics. It should be remembered, indeed, that both wheat and barley will flourish under very temperate conditions. Again, the record of the climatic circumstances under which the extremely bad crop of 1856 was produced, shows some points in respect to which, considered by themselves, it might be judged to have been more favourable for luxuriance than 1854. It is only when the fluctuations of temperature, the continuity of the wetness, and the adaptations of heat and moisture to stage of growth, are borne in mind, that the result becomes intelligible.

These two instances, so strikingly contrasted in their results, forcibly illustrate the necessity, not only of very careful and detailed study of the meteorological registry, but also of due consideration of its indications in their bearings upon the coincident stage and tendency of growth of the plant, if we would attain any really clear conception of the connection between the ever fluctuating characters of season, and the equally fluctuating characters of growth and produce.

Comparison of the average Annual Produce of Barley over the first 10, *the second* 10, *and the total period of* 20 *years.*

There is still another point in connection with the influence of season upon the crop, which should be considered before treating more exclusively of the effects of the different manures. Thus, before attempting to compare the effects of different manures, used year after year on the same plot, it is obviously necessary to form a judgment whether the earlier or the later seasons of the series were, in themselves, the most favourable, so as to distinguish as far as possible between the results due, on the one hand to more or less favourable seasons, and on the other to the direct action of the manures, in maintaining a suitable balance of the required constituents in the soil, or in inducing exhaustion, or accumulation, as the case may be.

In Table XXIII. there is given the average produce over the first ten, the second ten, and the total period of twenty years, by very different descriptions of manure, and a comparison of the results will illustrate the point in question. The plots selected are 5 out of the 7 quoted in the preceding Tables, namely—that manured with farmyard-manure every year; the continuously unmanured plot; the one with mixed mineral manure alone every year; that with 200 lbs. ammonia-salts alone every year; and that with both mixed mineral manure and 200 lbs. ammonia-salts every year. It is obvious that these five plots supply very various, and very opposite soil-conditions, so that the comparative effects of the seasons on each must have considerable significance.

In the first place, there is, with each of the five very opposite conditions of manuring, a considerably higher average weight per bushel of dressed corn over the second, than over the first ten years of the twenty; and the superiority is the greatest with the highest manuring and the heaviest crops—namely, with farmyard-manure, and with ammonia-salts and mixed mineral manure together. The proportion of corn to straw is also the higher over the last ten years, and the higher with the heavier crops. Further evidence that the later years were in the main more favourable than the earlier, at least for the production and maturation of grain, is to be found in the fact that there was also a less proportion of offal corn during the second half of the total period.

With a considerable difference in the weight per bushel of the dressed corn, it is obvious that the comparative productiveness

TABLE XXIII.—Average Annual quantity and quality of Barley, on Selected Plots, over the first 10 years, the second 10 years, and the Total Period of 20 years.

Plots.	MANURES, PER ACRE.	AVERAGE ANNUAL PRODUCE, &c. First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period 20 Years, 1852–'71.	Second 10 Years over (or under –) First 10.
	Weight per Bushel of Dressed Corn.				
		lbs.	lbs.	lbs.	Per Cent.
7	14 Tons Farm-yard Manure	52·6	56·0	54·3	6·5
1 O	Unmanured	51·6	53·1	52·3	2·9
4 O	Mixed Mineral Manure	52·3	54·6	53·4	4·4
1 A	200 lbs. Ammonia-salts	51·2	53·0	52·1	3·5
4 A	200 lbs. Amm.-salts, Mixed Min. Man.	52·2	55·7	54·0	6·7
	Total Corn per Acre, reckoned at 52 lbs. per Bushel.				
		Bushels.	Bushels.	Bushels.	Per Cent.
7	14 Tons Farm-yard Manure	$48\frac{7}{8}$	$57\frac{1}{2}$	$53\frac{1}{4}$	17·6
1 O	Unmanured	$24\frac{5}{8}$	$18\frac{7}{8}$	$21\frac{3}{4}$	–23·4
4 O	Mixed Mineral Manure	$32\frac{7}{8}$	$26\frac{5}{8}$	$29\frac{3}{4}$	–16·0
1 A	200 lbs. Ammonia-salts	$36\frac{3}{4}$	34	$35\frac{3}{8}$	– 7·5
4 A	200 lbs. Amm.-salts, Mixed Min. Man.	$49\frac{3}{4}$	$51\frac{1}{4}$	$50\frac{1}{2}$	3·0
	Straw (and Chaff), per Acre.				
		Cwts.	Cwts.	Cwts.	Per Cent.
7	14 Tons Farm-yard Manure	$26\frac{5}{8}$	$29\frac{7}{8}$	$28\frac{1}{4}$	12·2
1 O	Unmanured	$13\frac{3}{8}$	$10\frac{1}{4}$	$11\frac{3}{4}$	–23·4
4 O	Mixed Mineral Manure	$16\frac{1}{8}$	$12\frac{5}{8}$	$14\frac{3}{8}$	–21·7
1 A	200 lbs. Ammonia-salts	$19\frac{3}{4}$	$17\frac{3}{8}$	$18\frac{1}{2}$	–12·0
4 A	200 lbs. Amm.-salts, Mixed Min. Man.	$28\frac{7}{8}$	28	$28\frac{1}{2}$	– 3·0
	Total Produce (Corn and Straw), per Acre.				
		lbs.	lbs.	lbs.	Per Cent.
7	14 Tons Farm-yard Manure	5525	6342	5933	14·8
1 O	Unmanured	2782	2126	2454	–23·6
4 O	Mixed Mineral Manure	3517	2807	3162	–20·2
1 A	200 lbs. Ammonia-salts	4119	3719	3919	– 9·7
4 A	200 lbs. Amm.-salts, Mixed Min. Man.	5827	5808	5817	– 0·3
	Corn to 100 Straw.				
7	14 Tons Farm-yard Manure	85·6	91·3	88·5	6·7
1 O	Unmanured	85·9	87·3	86·6	1·6
4 O	Mixed Mineral Manure	95·1	97·7	96·4	2·7
1 A	200 lbs. Ammonia-salts	86·4	91·9	89·2	6·4
4 A	200 lbs. Amm.-salts, Mixed Min. Man.	79·9	86·4	83·2	8·1

of the two periods will not be accurately represented by the actual number of bushels of dressed corn in each case. Accordingly, as before, the quantity of *total corn* has been calculated into assumed bushels of the uniform weight of 52 lbs. These results show, without manure, with mineral manure alone, and with ammonia-salts alone—that is, with defective soil-conditions, a considerable deficiency of corn over the second half of the period; the greater the more defective the manuring, and the greater the relative deficiency of nitrogen in the soil; for the falling off is considerably more marked with mineral-manure alone, than with ammonia-salts alone. Under the same three soil-conditions there is as great, or even a greater deficiency of straw, and consequently of total produce also, during the later years.

With farmyard-manure, on the other hand, the annual use of which has resulted in a very great accumulation within the soil, not only of nitrogen, but probably of every mineral constituent also, there has been a considerable excess of produce of both corn and straw, but especially of corn, over the second as compared with the first ten years.

With the ammonia-salts and mixed mineral manure together, by which also the soil has become much richer in most mineral constituents, and at any rate less exhausted if not richer in nitrogen than without manure or with mineral manure alone, there is again a slight increase of corn, but a slight deficiency of straw, over the later years.

The general conclusion from the above results, as well as from others, not here specially referred to, is, that the earlier years of the twenty were, on the average, as favourable, if not more favourable, for quantity of total produce—that is for luxuriance—than the later; but that the later seasons were much more favourable for tendency to seed-forming, and also for the maturation of the grain.

Bearing in mind this conclusion as to the progressive or retrogressive characters of the seasons themselves, we shall be in a position the better to judge of the effects of the different manures when used year after year, for twenty years in succession, on the same land.

(*To be continued.*)

EXPERIMENTS on the GROWTH of BARLEY year after year on the same land, without MANURE, and with different descriptions of MANURE. Hoos Field, Rothamsted.

APPENDIX—TABLE I.—Showing, *taken together with the side-notes*, the description and quantities of the Manures applied per Acre on each Plot, in each year of the Twenty, 1852—1871 inclusive.

[N.B. This Table has reference to all the succeeding Appendix-Tables, and when used should be drawn out to the left, free of the book.]

NOTES TO APPENDIX—TABLE I.	PLOTS.	MANURES PER ACRE, PER ANNUM (*unless otherwise stated in the side-notes*).	PLOTS.
(1) "3½ cwts. Superphosphate of Lime"—in all cases, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric acid sp. gr. 1·7 (and water).	1 O. 2 O. 3 O. 4 O.	Unmanured continuously 3½ cwts. Superphosphate of Lime (1) 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate	1 O. 2 O. 3 O. 4 O.
(2) Sulphate Potass—300 lbs. per annum for the first 6 years, 1852-7. (3) Sulphate Soda—200 lbs. per annum for the first 6 years, 1852–7. (4) The "Ammonia-salts"—in all cases equal parts of Sulphate and Muriate of Ammonia of Commerce.	1 A. 2 A. 3 A. 4 A.	200 lbs. Ammonia-salts (4) 200 lbs. Ammonia-salts, 3½ cwts. Superphosphate 200 lbs. Ammonia-salts, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia 200 lbs. Ammonia-salts, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate	1 A. 2 A. 3 A. 4 A.
(5) Plots "AA" and "AAS"—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."	(5) 1 AA. 2 AA. 3 AA. 4 AA.	275 lbs. Nitrate Soda 275 lbs. Nitrate Soda, 3½ cwts. Superphosphate 275 lbs. Nitrate Soda, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia 275 lbs. Nitrate Soda, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate	1 AA. 2 AA. 3 AA. 4 AA. (5)
(6) Plots "AAS"—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 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.	(5) 1 AAS. 2 AAS. 3 AAS. 4 AAS.	275 lbs. Nitrate Soda, 400 lbs. (6) Silicate Soda 275 lbs. Nitrate Soda, 400 lbs. (6) Silicate Soda, 3½ cwts. Superphosphate 275 lbs. Nitrate Soda, 400 lbs. (6) Silicate Soda, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Mag. 275 lbs. Nitrate Soda, 400 lbs. (6) Silicate Soda, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwts. Superphos.	1 AAS. 2 AAS. 3 AAS. 4 AAS. (5)
(7) 2000 lbs. Rape-cake per annum for the first 6 years, and 1000 lbs. only, each year since.	(7) 1 C. 2 C. 3 C. 4 C.	1000 lbs. Rape-cake 1000 lbs. Rape-cake, 3½ cwts. Superphosphate 1000 lbs. Rape-cake, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia 1000 lbs. Rape-cake, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate	1 C. 2 C. 3 C. 4 C. (7)
(8) 300 lbs. Sulphate Potass, and 3½ cwts. Superphosphate of Lime, without Nitrate of Soda, the first year (1852); Nitrate alone each year since.	(8) 1 N. 2 N.	275 lbs. Nitrate Soda 275 lbs. Nitrate Soda (550 lbs. Nitrate for 5 years, 1853, 4, 5, 6, and 7)	1 N. 2 N. (8)
(9) Sulphate Soda—200 lbs. per annum 1855, 6, and 7.	M. 5 O. 5 A.	100 lbs. (9) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate (commencing 1855; 1852, 3, and 4, unmanured) 200 lbs. (2) Sulphate Potass, 3½ cwts. Superphosphate (200 lbs. Ammonia-salts also, for the first year, 1852, only) 200 lbs. (2) Sulphate Potass, 3½ cwts. Superphosphate, 200 lbs. Ammonia-salts	M. 5 O. 5 A.
	6 {1 6 {2	Unmanured continuously Ashes (burnt soil and turf)	1 }6 2 }6
	7	14 Tons Farm-yard Manure	7

EXPERIMENTS on the GROWTH of BARLEY year after year on the same LAND, without

APPENDIX—TABLE II. Dressed

[N.B. The double vertical lines show that there was a change in the description, or quantity, of Manure,

PLOTS.	HARVESTS.											
	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1 O.	27¼	25⅝	35	31	13⅞	26½	21⅛	13½	13¾	16¼	16½	22⅞
2 O.	28⅝	33½	40⅝	36¼	17⅞	33¼	28⅞	19⅜	15⅞	25	21⅞	32⅞
3 O.	26⅛	27⅝	36½	34⅞	16⅞	32	24¼	15⅞	15¼	18⅞	19⅞	27⅛
4 O.	32¾	35⅝	42	37⅛	19⅞	39⅞	30⅞	19⅞	18¼	29⅞	25⅛	33
Means	28¾	30⅞	38½	34⅞	17	32¾	26¾	17¼	15⅝	22⅞	20⅞	29⅞
1 A.	36⅞	38⅝	47¾	44½	25	38⅞	31½	15⅝	26⅛	30½	31⅞	45⅛
2 A.	38⅝	40⅛	60½	47¾	29½	56½	51⅞	34½	43⅛	55	48⅞	61⅜
3 A.	36	36½	50	44½	28⅞	42⅝	34¼	16⅞	28	32⅞	35¼	48⅛
4 A.	40⅞	38¼	60⅝	48⅞	31⅞	57⅛	51½	34⅝	43½	54⅜	47⅛	55⅞
Means	38⅛	38⅞	54⅞	46¼	28½	48⅞	42⅛	25⅛	35⅛	43¾	40⅞	52⅞
1 AA.	44½	40¾	56⅝	48	36¼	49¾	39⅞	21½	25⅞	35	31½	49
2 AA.	43¾	42¼	63½	50⅞	31½	66½	56¼	35⅞	43¼	55¾	51	60½
3 AA.	41¾	41¾	51⅛	47¼	25⅞	49⅞	40⅞	20⅞	30⅞	36⅞	36¼	54
4 AA.	45⅛	44½	62¾	49⅝	37⅝	64⅞	56⅛	35⅞	46¼	55⅞	48⅞	59½
Means	43⅞	42⅛	58½	48⅞	32⅞	57¾	48⅛	28⅜	36⅞	45⅞	41⅞	53⅞
1 AAS.												
2 AAS.												
3 AAS.												
4 AAS.												
Means												
1 C.	39⅛	39⅞	60⅞	48¼	36⅞	64⅛	53¾	38⅞	31¾	56½	41	51⅞
2 C.	36½	36⅛	60⅞	53½	37⅛	62¼	57⅞	41	34¼	51⅞	45	55
3 C.	33½	35¼	56½	48⅞	32⅝	60¾	52	34⅛	35¼	51⅛	36	53⅛
4 C.	38	40⅛	60¼	51¾	35⅞	62¼	57⅛	35	40¾	53⅞	45½	51½
Means	36¾	37⅞	59½	50⅞	35½	62¼	55	37¼	36⅛	54½	41⅞	53⅞
1 N.	} (25⅞) {	34⅞	49⅞	50	28½	47⅞	37⅞	24⅞	27⅞	38¼	35½	61½
2 N.		37⅛	53¼	49⅞	42	58	43⅞	26½	29¾	41⅞	38⅞	53⅛
M.				39⅛	15⅞	24½	25⅞	19½	10⅞	27⅞	23⅞	28⅛
5 O.	(36½)	27½	30⅞	32⅞	19⅞	31⅛	25¼	16½	11⅛	28⅞	17⅞	29⅛
5 A.	36½	40⅛	51⅞	47⅞	33⅛	54⅞	48⅛	33⅛	39	49⅞	40⅞	51⅛
6 {1	29	26½	35⅛	37¼	15⅛	34⅞	26½	17⅛	12¼	16⅞	18½	27¾
6 {2	25⅛	27⅞	33¼	36¼	15⅝	31⅛	25¼	14⅞	12⅛	17⅞	19	28⅛
7	53	36⅛	56⅞	50⅛	32⅛	51¼	55	40	41⅞	54⅞	49¾	59½

(1) Averages of 4 years, 4 years, and 8 years. (2) Averages of 9 years (1853–'61), last 10 years,
(3) Averages of 9 years (1853–'61),

Manure, and with different descriptions of Manure. Hoos Field, Rothamsted.

Corn per Acre—Bushels.

at the period indicated, for particulars of which see *Appendix—Table I.*, and sides-notes thereto, p. 163.]

Harvests. 1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	Average Annual. First 10 Years, 1852-'61	Second 10 Years, 1862-'71.	Total Period, 20 Years, 1852-'71.	Plots.
Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	
24	18	15⅞	17⅛	15⅜	15⅛	13½	16¾	22⅜	17½	20	1 O.
30¾	22½	22⅛	24⅜	18½	18¼	18	23⅛	27⅞	23¼	25½	2 O.
26⅛	22	19⅜	17	14¼	18¾	16¾	19⅜	24¼	20⅛	22⅛	3 O.
33¼	24⅜	24	20⅞	17⅜	22¼	18½	25	30¾	24⅞	27½	4 O.
28⅜	21¾	20⅞	19⅞	16⅛	18⅝	16¾	21⅛	26⅛	21¼	23⅞	Means
38⅜	29⅞	27⅛	30⅜	20⅞	27⅞	27¾	36⅜	33⅜	31¼	32½	1 A.
58⅛	48⅞	50⅛	44	37⅝	48	41⅛	45⅛	45⅛	48⅛	47	2 A.
43⅞	39¼	27⅛	33	25	34¾	30⅞	38⅛	35	35	35	3 A.
55⅜	46½	47	48⅞	54⅜	49¼	38	46½	46⅛	46⅞	46¾	4 A.
49⅛	39⅜	38⅛	37⅞	29⅛	39⅞	34⅛	41½	40⅛	40¼	40¼	Means
41¾	33¾	29⅛	29¾	27	32⅛	29¼	39⅛	39¾	34¼	37	1 AA.
56⅞	47½	50⅞	44¼	44	48¼	46¼	46½	48⅞	49⅝	49¼	2 AA.
44⅜	34⅛	29¾	32⅞	27½	33⅞	32⅞	36⅛	38⅞	36⅛	37⅛	3 AA.
56⅛	48⅞	50⅞	45	45⅞	49⅞	44½	46	49⅞	49½	49¾	4 AA.
49⅞	41⅛	40⅛	38	36	41	38⅛	42	44¼	42⅛	43⅞	Means
44⅛	34⅞	37⅞	32¼	29⅞	34¾	35	48⅛	(1) 37¼	36⅞	37 (1)	1 AAS.
54⅞	47¼	51⅛	44	36⅞	49⅞	44¾	49½	49¼	45⅛	47¼	2 AAS.
50	41	41⅞	39½	44⅞	40½	42¾	48⅞	43⅛	44⅛	43⅞	3 AAS.
59⅛	50½	50¾	45¼	46⅛	51¾	47¼	48⅞	51⅛	48⅜	50	4 AAS.
52	43⅞	45⅜	40¼	39⅜	44¼	42½	48¾	45¼	43¼	44½	Means
48⅜	45	45⅞	38½	37	42½	41¾	41	47	43⅞	45¼	1 C.
51¾	46⅛	47⅛	45½	35¼	48¼	41¾	41¾	47¾	45¾	46¾	2 C.
49⅞	48¾	43⅞	38⅞	35⅛	43⅜	38½	45⅛	44	43¾	43⅝	3 C.
53	48⅛	48⅜	42⅝	36¼	52⅛	43¾	47½	47⅞	47¼	47⅛	4 C
50½	47	46½	41⅜	35⅞	46⅜	41½	44¼	46½	45	45¾	Means
40¾	37	34⅜	33	25½	35¼	34¾	43⅛	(2) 37⅛	37⅛	37⅞ (2)	1 N.
46⅛	39⅞	41	36⅜	25⅛	38⅛	40¼	45⅛	47⅞	40½	41⅞	2 N.
25⅛	19¾	19	20½	14¾	16⅜	16⅛	22⅛	(3)(22⅞	20⅜	21⅛)(3)	M.
26⅛	23	22½	19½	15	23⅜	14½	20	(4)(21⅞	21⅛	22¾)(4)	5 O.
50⅛	48¾	43⅞	34⅞	36⅛	49⅞	41¾	44¾	43⅛	44¾	44⅛	5 A.
25⅛	21	16⅛	16⅞	15¾	14⅞	15¾	18⅞	25	18⅞	22	1 } 6
25⅛	19¼	17¼	19¾	15⅞	15⅜	15⅛	24¼	23⅞	20	21⅞	2 } 6
62	52¾	53⅛	45⅜	43⅜	46⅞	47½	54¼	45	51½	48¼	7

and total 19 years. (1) Averages of 7 years (1855–'61), last 10 years, and total 17 years.
last 10 years, and total 19 years.

EXPERIMENTS on the GROWTH of BARLEY year after year on the same LAND, without

APPENDIX—TABLE III. Weight

[N.B. The double vertical lines show that there was a change in the description, or quantity, of Manure,

PLOTS.	HARVESTS. 1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1 O.	52·1	51·4	53·6	52·4	49·1	52·0	53·0	49·0	50·8	52·3	50·3	53·6
2 O.	52·6	52·6	54·0	52·5	46·5	52·8	54·0	52·0	50·5	53·3	52·0	54·2
3 O.	52·5	51·9	53·6	52·9	48·5	52·5	53·5	49·5	50·3	52·8	51·8	54·5
4 O.	51·5	52·1	54·0	53·1	47·0	53·7	54·0	52·5	51·3	54·0	52·0	54·8
Means	52·2	52·0	53·8	52·7	47·8	52·8	53·6	50·8	50·7	53·1	51·5	54·3
1 A.	50·7	52·4	53·6	51·8	48·5	51·9	53·0	47·5	50·8	51·5	49·4	53·6
2 A.	50·5	52·5	54·3	51·3	46·3	54·3	53·8	51·0	51·0	53·5	53·5	55·3
3 A.	50·9	52·6	54·0	52·2	49·1	52·1	54·0	47·5	50·8	51·5	50·5	54·3
4 A.	51·4	53·1	54·3	52·0	46·4	54·8	54·0	51·0	51·1	54·0	54·0	56·5
Means	50·9	52·7	54·1	51·8	47·6	53·3	53·7	49·3	50·9	52·6	51·9	54·9
1 AA.	49·1	51·3	52·8	50·6	48·3	52·0	53·5	47·5	50·7	51·8	50·0	53·9
2 AA.	49·5	51·7	52·4	50·1	46·1	53·5	53·3	50·7	51·3	53·5	54·4	55·7
3 AA.	50·6	51·3	53·1	50·2	47·3	52·1	53·9	47·5	50·4	51·5	51·5	54·5
4 AA.	50·6	51·4	52·1	48·9	45·4	53·9	53·5	50·5	51·0	53·5	54·0	56·4
Means	50·0	51·4	52·6	50·0	46·8	52·9	53·6	49·1	50·9	52·6	52·5	55·1
1 AAS.												
2 AAS.												
3 AAS.												
4 AAS.												
Means												
1 C.	51·7	51·3	52·9	50·5	46·1	53·2	53·5	52·0	52·0	54·0	54·5	56·3
2 C.	51·8	51·6	52·8	50·0	47·3	53·8	52·8	51·5	51·5	54·1	55·3	56·4
3 C.	51·3	51·5	52·6	50·6	46·6	54·1	53·5	51·7	51·8	53·5	53·5	56·8
4 C.	51·4	50·4	52·8	49·5	46·3	54·1	53·1	51·0	51·1	54·3	54·0	56·7
Means	51·6	51·2	52·8	50·2	46·6	53·8	53·2	51·6	51·6	54·0	54·3	56·6
1 N.	(51·7)	51·3	53·3	52·0	50·0	52·9	53·5	48·0	51·0	52·0	51·5	53·4
2 N.		49·7	53·1	50·1	48·4	53·0	54·0	48·5	51·1	51·8	51·3	53·9
M.				52·6	49·3	52·6	53·6	49·5	51·0	53·8	52·8	53·8
5 O	(51·0)	51·8	53·1	52·6	47·5	53·4	54·0	51·0	51·0	53·3	51·5	54·1
5 A	51·0	52·3	53·8	51·5	46·6	54·5	54·0	51·0	51·2	53·0	52·0	55·6
6 {1	52·0	50·3	52·8	52·5	50·0	52·3	53·1	48·5	51·3	52·0	51·8	54·0
6 {2	53·0	50·9	53·6	52·6	50·0	52·3	53·1	47·5	51·0	52·0	52·0	54·1
7	52·8	51·6	53·9	52·9	47·1	54·2	54·5	52·5	52·1	54·8	54·8	57·2

(1) Averages of 4 years, 4 years, and 8 years.

(2) Averages of 9 years (1853–'61), last 10 years,

(4) Averages of 9 years (1853–'61),

MANURE, and with different descriptions of Manure. Hoos Field, Rothamsted.

per Bushel of Dressed Corn—lbs.

at the period indicated, for particulars of which see *Appendix—Table I.*, and side-notes thereto, p. 163.]

HARVESTS.								AVERAGE ANNUAL.			PLOTS.
1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.	
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
55·7	53·9	51·1	51·8	54·3	52·4	52·9	55·0	51·6	53·1	52·3	1 O.
56·8	53·8	53·2	53·9	55·8	54·3	53·6	56·0	52·0	54·4	53·2	2 O.
56·9	54·5	52·3	52·9	55·7	54·7	54·3	55·4	51·8	54·3	53·0	3 O.
57·3	54·0	52·7	53·6	55·3	54·6	55·6	55·6	52·3	54·6	53·4	4 O
56·7	54·1	52·3	53·1	55·3	54·0	54·1	55·5	52·0	54·1	53·0	Means
55·4	53·8	50·9	51·3	53·3	52·4	54·6	55·6	51·2	53·0	52·1	1 A.
57·0	52·7	54·4	54·1	54·6	57·0	57·2	55·0	51·8	55·1	53·5	2 A.
56·4	54·7	52·1	51·9	54·8	54·6	55·4	56·1	51·5	54·1	52·8	3 A.
57·6	53·5	54·7	54·3	55·6	57·4	57·1	56·5	52·2	55·7	54·0	4 A.
56·6	53·7	53·0	52·9	54·6	55·4	56·1	55·8	51·6	54·5	53·1	Means
55·5	53·5	50·9	52·4	53·7	53·1	54·5	54·1	50·8	53·2	52·0	1 AA.
57·2	52·3	55·0	54·1	55·6	57·2	56·9	55·9	51·2	55·4	53·3	2 AA.
56·5	54·8	51·4	51·9	55·1	53·7	54·6	54·3	50·8	53·8	52·3	3 AA.
57·6	53·3	55·4	54·6	56·0	57·1	57·1	56·3	51·1	55·8	53·4	4 AA.
56·7	53·5	53·2	53·3	55·1	55·3	55·8	55·2	51·0	54·6	52·8	Means
56·1	54·2	51·8	53·5	54·2	54·8	55·0	54·6	(1) 53·9	54·6	54·3 (1)	1 AAS.
57·2	52·4	55·6	55·1	55·5	57·4	57·4	55·6	(1) 55·1	56·5	55·8 (1)	2 AAS.
57·2	54·8	52·5	53·0	56·2	56·6	55·9	53·8	(1) 54·4	55·6	55·0 (1)	3 AAS.
57·0	53·1	55·3	54·1	56·2	57·8	57·8	55·4	(1) 54·9	56·8	55·8 (1)	4 AAS.
56·9	53·6	53·8	53·9	55·5	56·7	56·5	54·9	54·6	55·9	55·2	Means
57·1	53·8	55·1	54·4	56·2	56·7	57·5	56·3	51·7	55·8	53·8	1 C.
57·0	53·3	55·7	55·0	56·1	57·1	57·8	56·4	51·7	56·0	53 9	2 C.
57·3	53·3	55·3	54·7	55·8	57·1	57·6	56·3	51·7	55·8	53·7	3 C.
57·2	53·5	55·6	54·8	55·4	57·4	58·0	56·4	51·4	55·9	53·6	4 C.
57·1	53·5	55·4	54·7	55·9	57·1	57·7	56·4	51·6	55·9	53·8	Means
56·0	54·1	52·0	52·9	52·8	54·3	55·6	54·6	(2) 51·6	53·7	52·7 (2)	1 N.
56·5	53·8	52·8	52·7	55·5	54·8	55·8	54·6	(2) 51·1	54·2	52·7 (2)	2 N.
56·3	54·4	52·9	53·9	54·0	54·0	55·3	55·0	(3)(51·8	54·2	53·2)(3)	M.
57·6	54·5	53·4	54·0	56·4	55·6	55·9	55·1	(4)(52·0	54·8	53·4)(4)	5 O.
57·5	54·1	54·8	55·2	57·5	57·5	57·3	55·5	51·9	55·7	53·8	5 A.
56·0	53·9	51·3	52·0	53·5	52·8	54·0	55·4	51·5	53·5	52·5	1 } 6
55·8	53·9	51·8	52·5	53·8	52·9	54·6	54·9	51·6	53·6	52·6	2 } 6
57·4	54·4	54·9	54·8	57·1	56·4	57·1	56·6	52·6	56·0	54·3	7

and total 19 years. (3) Averages of 7 years (1855–'61), last 10 years, and total 17 years
last 10 years, and total 19 years.

EXPERIMENTS on the GROWTH of BARLEY year after year on the same LAND, without

APPENDIX—TABLE IV. Offal

[N.B. The double vertical lines show that there was a change in the description, or quantity, of Manure,

PLOTS	HARVESTS.											
	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1 O.	164	225	84	144	131	93	86	110	78	88	64	49
2 O.	100	101	101	69	58	106	103	159	84	78	114	58
3 O.	183	151	64	76	129	61 |	96	85	78	88	73	54
4 O.	136	160	105	94	88	53 |	108	160	74	58	117	57
Means	146	159	89	96	102	78	98	129	78	78	92	55
1 A.	218	253	201	138	219	113	98	184	150	170	269	116
2 A.	260	244	150	184	121	88	114	274	159	130	191	99
3 A.	252	336	197	177	180	91 |	96	175	115	109	269	108
4 A.	273	274	138	142	125	70 |	117	253	150	110	150	81
Means	251	277	172	160	161	91	106	222	143	130	220	101
1 AA.	299	303	326	204	310	135	| 88	215	109	173	296	110
2 AA.	315	251	329	181	233	133	| 134	320	118	190	133	143
3 AA.	318	236	334	212	290	108 |	| 118	265	122	138	364	95
4 AA.	246	301	273	150	176	183 |	| 143	285	141	179	191	66
Means	294	273	316	187	252	140	121	271	123	170	246	103
1 AAS.												
2 AAS.												
3 AAS.												
4 AAS.												
Means												
1 C.	170	268	178	219	173	135	| 103	225	120	154	154	85
2 C.	164	376	238	195	161	169	| 148	171	156	150	128	109
3 C.	190	296	248	183	189	156 |	| 105	236	115	204	190	71
4 C.	144	277	227	222	205	168 |	| 125	350	153	204	174	66
Means	167	304	223	205	182	157	120	246	136	178	161	83
1 N.	} (94) {	283 |	109	128	245	99	119	205	146	225	245	120
2 N.		228 |	286	224	193	151 |	110	235	179	190	216	114
M.			|	36	94	90	| 84	85	75	78	198	46
5 O.	(173) |	68	113	50	96	101	| 71	110	73	73	193	41
5 A.	173	210	170	126	151	68	| 154	168	193	188	210	81
6 {1	120	200	144	116	152	72	84	121	88	73	75	51
6 {2	118	161	119	73	125	105	81	127	95	67	194	65
7	101	269	86	109	141	134	121	260	147	190	208	66

(1) Averages of 4 years, 4 years, and 8 years.

(2) Averages of 9 years (1853–'61), last 10 years,

(4) Averages of 9 years (1853–'61),

MANURE, and with different descriptions of MANURE. Hoos Field, Rothamsted.

Corn per Acre—lbs.

at the period indicated, for particulars of which see *Appendix—Table I.*, and side-notes thereto, p. 163.]

HARVESTS.								AVERAGE ANNUAL.			
1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.	PLOTS.
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
42	47	41	90	21	44	31	48	120	48	84	1 O.
69	38	21	53	29	89	18	33	96	52	74	2 O.
43	38	38	64	27	70	18	35	101	46	74	3 O.
41	28	55	60	25	69	26	48	104	53	78	4 O.
49	38	39	67	25	68	23	41	105	50	78	Means
99	58	94	115	49	139	23	105	174	107	141	1 A.
63	84	64	76	38	113	26	189	172	94	133	2 A.
83	51	106	94	34	95	24	89	173	95	134	3 A.
110	60	63	71	50	21	27	146	165	78	122	4 A.
89	63	82	89	43	92	25	132	171	94	133	Means
110	64	148	110	46	64	33	133	216	111	164	1 AA.
50	113	111	69	46	89	24	168	220	95	158	2 AA.
76	48	103	106	59	111	36	133	214	113	164	3 AA.
46	76	133	119	43	78	30	90	208	87	148	4 AA.
71	75	124	101	48	86	31	131	215	102	159	Means
94	55	88	85	49	121	33	94	(1) 81	74	77 (1)	1 AAS
53	86	96	66	39	60	23	153	(1) 75	69	72 (1)	2 AAS.
70	50	141	79	64	136	29	130	(1) 85	90	87 (1)	3 AAS.
93	70	80	93	46	125	26	175	(1) 84	93	89 (1)	4 AAS.
77	65	101	81	50	111	28	138	81	82	82	Means
78	83	104	109	43	69	25	78	175	83	129	1 C.
92	44	89	89	64	111	24	88	193	84	138	2 C.
90	66	94	91	39	91	37	141	192	91	142	3 C.
123	69	128	72	42	67	28	124	208	89	149	4 C.
96	66	104	90	47	85	28	108	192	87	139	Means
74	98	124	119	61	150	33	99	(2) 173	112	141 (2)	1 N.
95	84	104	88	35	98	33	171	(2) 199	104	149 (2)	2 N.
58	69	44	56	26	61	25	58	(3) (77	64	69) (3)	M.
78	35	48	56	20	75	23	41	(4) (84	61	72) (4)	5 O.
91	94	53	74	33	63	30	144	160	87	124	5 A.
51	45	72	103	27	71	26	50	117	57	87	1 } 6
54	47	51	83	21	57	23	41	107	64	85	2 } 6
117	56	148	111	48	100	26	171	156	105	130	7

and total 19 years. (2) Averages of 7 years (1855–'61), last 10 years, and total 17 years.
last 10 years, and total 19 years.

EXPERIMENTS on the GROWTH of BARLEY year after year on the same LAND, without

APPENDIX—TABLE V. Total

[N.B. The double vertical lines show that there was a change in the description, or quantity, of Manure,

PLOTS.	HARVESTS.											
	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs,	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1 O.	1585	1552	1963	1773	812	1453	1207	775	753	941	899	1276
2 O.	1605	1867	2298	1973	886	1861	1657	1179	884	1410	1253	1814
3 O.	1558	1586	2021	1918	936	1741	1396	872	847	1084	1094	1557
4 O.	1819	2017	2374	2067	1018	2191	1780	1197	1013	1648	1428	1868
Means	1642	1755	2164	1933	913	1811	1510	1006	874	1271	1168	1629
1 A.	2088	2285	2763	2443	1432	2133	1771	919	1501	1745	1821	2406
2 A.	2212	2352	3437	2639	1467	3161	2879	2034	2371	3073	2791	3511
3 A.	2091	2259	2897	2504	1577	2302	1946	977	1540	1799	2049	2748
4 A.	2368	2309	3428	2659	1599	3216	2897	2017	2375	3059	2725	3210
Means	2190	2301	3131	2561	1519	2703	2374	1487	1947	2419	2346	2969
1 AA.	2486	2394	3313	2640	2061	2725	2198	1237	1395	1986	1874	2753
2 AA.	2483	2435	3643	2707	1687	3696	3131	2140	2338	3178	2908	3515
3 AA.	2431	2358	3075	2586	1489	2708	2311	1235	1672	2038	2234	3042
4 AA.	2532	2590	3539	2582	1886	3677	3155	2092	2501	3169	2824	3429
Means	2483	2444	3393	2629	1781	3202	2699	1676	1977	2593	2460	3185
1 AAS.												
2 AAS.												
3. AAS.												
4 AAS.												
Means												
1 C.	2193	2318	3388	2668	1870	3547	2980	2245	1773	3209	2389	3005
2 C.	2057	2243	3444	2857	1916	3521	3174	2284	2051	3227	2619	3213
3 C.	1907	2113	3221	2659	1711	3417	2887	2001	1943	2944	2118	3089
4 C.	2098	2302	3413	2783	1841	3536	3162	2135	2238	3111	2634	3159
Means	2064	2244	3366	2742	1834	3505	3051	2166	2001	3123	2440	3117
1 N.	}(1437){	2044	2740	2727	1675	2634	2144	1400	1546	2215	2075	2875
2 N.		2071	3113	2696	2225	3226	2480	1525	1703	2345	2184	3016
M.				1730	1016	1379	1476	1055	618	1563	1443	1562
5 O.	(2034)	1493	1748	1759	1009	1764	1441	955	593	1598	1088	1641
5 A.	2034	2306	2959	2596	1700	3061	2754	1857	2188	2808	2635	2944
6 {1	1627	1521	1998	2074	910	1899	1496	954	719	940	1031	1527
6 {2	1451	1555	1904	1982	923	1738	1422	831	718	1000	1182	1613
7	1844	2136	3127	2765	1656	2915	3118	2362	2319	3169	2936	3473

(1) Averages of 4 years, 4 years, and 8 years. (2) Averages of 9 years (1853–'61), last 10 years,

(4) Averages of 9 years (1853–'61),

MANURE, and with different descriptions of MANURE. Hoos Field, Rothamsted.

Corn per Acre—lbs.

at the period indicated, for particulars of which see *Appendix—Table I.*, and side-notes thereto, p. 163.]

HARVESTS.								AVERAGE ANNUAL.			PLOTS.
1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.	
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
1379	1018	858	978	873	840	751	973	1281	985	1133	1 O.
1790	1252	1216	1386	1060	1079	986	1329	1562	1317	1439	2 O.
1526	1237	1041	962	824	1097	928	1125	1396	1139	1268	3 O.
1949	1349	1323	1180	998	1286	1053	1438	1712	1387	1550	4 O.
1661	1214	1109	1126	939	1075	929	1216	1488	1207	1347	Means
2258	1666	1474	1686	1136	1599	1539	2129	1908	1771	1840	1 A.
3399	2636	2809	2458	2092	2849	2404	2672	2563	2762	2662	2 A.
2563	1872	1541	1808	1406	1994	1733	2231	1989	1995	1992	3 A.
3316	2549	2636	2454	1978	2848	2197	2769	2593	2668	2630	4 A.
2884	2181	2115	2101	1653	2322	1968	2450	2263	2299	2281	Means
2430	1875	1633	1669	1500	1773	1630	2250	2244	1939	2091	1 AA.
3300	2600	2913	2464	2492	2845	2655	2771	2744	2846	2795	2 AA.
2600	1920	1631	1814	1578	1929	1803	2098	2190	2065	2128	3 AA.
3299	2684	2954	2573	2586	2929	2571	2683	2772	2853	2813	4 AA.
2907	2270	2283	2130	2039	2369	2165	2451	2487	2426	2457	Means
2573	1948	2054	1811	1644	2029	1963	2721	(1) 2097	2089	2093 (1)	1 AAS.
3190	2564	2939	2490	2061	2924	2593	2904	(1) 2796	2621	2708 (1)	2 AAS.
2933	2299	2341	2173	2585	2429	2424	2731	(1) 2437	2542	2489 (1)	3 AAS.
3465	2751	2888	2543	2669	3118	2755	2886	(1) 2912	2857	2884 (1)	4 AAS.
3040	2391	2556	2254	2240	2625	2434	2811	2560	2527	2544	Means
2828	2508	2631	2209	2122	2482	2429	2561	2619	2516	2568	1 C.
3039	2503	2741	2594	2044	2867	2437	2445	2677	2650	2664	2 C.
2923	2666	2518	2221	1999	2584	2260	2695	2480	2507	2494	3 C.
3153	2648	2834	2411	2051	3065	2569	2809	2662	2733	2698	4 C.
2986	2581	2681	2359	2054	2750	2424	2628	2610	2602	2606	Means
2360	2101	1910	1866	1410	2064	1966	2451	(2) 2124	2108	2116 (2)	1 N.
2710	2226	2266	2008	1443	2218	2278	2650	(2) 2376	2300	2336 (2)	2 N.
1519	1145	1048	1161	821	957	915	1275	(3)(1262	1185	1217)(3)	M.
1610	1290	1248	1111	868	1378	835	1143	(4)(1373	1221	1293)(4)	5 O.
3015	2710	2461	2001	2114	2931	2424	2604	2426	2584	2505	5 A.
1461	1180	899	953	846	857	851	1091	1414	1070	1242	1 } 6
1454	1084	948	1121	876	873	853	1375	1352	1138	1245	2 } 6
3672	2923	3065	2614	2539	2746	2734	3243	2541	2995	2768	7

and total 19 years. (3) Averages of 7 years (1855–'61), last 10 years, and total 17 years.
last 10 years, and total 19 years.

EXPERIMENTS on the GROWTH of BARLEY year after year on the same LAND, without

APPENDIX—TABLE VI. Straw

[N.B. The double vertical lines show that there was a change in the description, or quantity, of Manure,

PLOTS.	HARVESTS.											
	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
1 O.	16 5/8	18	21 3/4	17 5/8	8 3/4	12 3/4	10 7/8	9 1/8	7 1/2	11	9 3/4	11 3/8
2 O.	16 1/2	17 1/8	23 1/4	17 3/4	8 3/4	15 5/8	14 7/8	12 1/4	8 7/8	13 1/4	12 7/8	15 5/8
3 O.	16 1/2	17 1/4	20 7/8	17 1/2	9 1/8	15	12 1/4	9 3/4	8 1/2	11 1/2	10 7/8	13 3/8
4 O.	19 1/2	20 1/2	23 1/8	18	9 1/8	17 1/8	16 1/8	12 1/4	9 5/8	15 3/8	13 1/2	15 3/8
Means	17 1/4	18 1/4	22 1/4	17 5/8	9	15 1/8	13 1/2	10 5/8	8 5/8	12 3/4	11 1/2	13 7/8
1 A.	22 7/8	23 3/4	30 1/4	24 1/8	17 1/8	17 3/4	15 1/2	11 1/2	14 7/8	19 5/8	20 3/8	21 3/8
2 A.	26	25 1/2	40 7/8	29 3/8	21 1/2	26 3/4	28 3/4	24 7/8	25 1/4	29 3/4	32 3/8	34
3 A.	23 5/8	25 1/8	33 3/4	27 1/2	17 7/8	21 3/8	17 7/8	13 1/2	16 1/4	21 1/2	23 1/4	26 1/4
4 A.	27 7/8	26 5/8	40 1/2	31	21 1/4	27 7/8	29 3/8	27 1/4	26 5/8	30 1/2	31 5/8	32
Means	25 1/8	25 1/4	36 3/8	28	19 1/2	23 1/2	22 1/8	19 1/4	20 3/4	25 3/8	26 3/4	28 3/8
1 AA.	26 7/8	26 1/8	37 7/8	32 1/8	24 1/2	23 1/2	19 1/8	14 1/2	13 1/2	22	21 1/4	25 1/8
2 AA.	28 3/8	28 3/8	44 3/8	38 5/8	31 5/8	32 7/8	32 5/8	26 1/2	24 1/4	31 5/8	31 1/2	32 1/2
3 AA.	26 3/8	27 1/4	37 7/8	34	26 1/8	26	22 1/8	16 1/8	18 1/8	24 1/8	24 3/4	27 7/8
4 AA.	28 3/8	31 5/8	49	39 7/8	33	36 1/4	35 3/4	30 5/8	29	33 5/8	33 1/8	34 3/4
Means	27 1/2	28 3/8	42 1/4	36 1/8	28 3/4	29 5/8	27 1/2	21 7/8	21 1/4	27 7/8	27 5/8	30
1 AAS.												
2 AAS.												
3 AAS.												
4 AAS.												
Means												
1 C.	24 5/8	26 7/8	43 1/4	36 1/8	26	33 1/8	30 3/4	26 7/8	17 7/8	27 7/8	26	28 5/8
2 C.	23 3/4	25 5/8	44 1/8	36 1/8	31 1/2	33 1/4	33 7/8	28 3/4	20 5/8	30 3/8	27 1/4	30 1/8
3 C.	21 7/8	25 1/4	41 1/4	35 7/8	26 1/2	30 7/8	30 3/4	25 5/8	20 1/8	30 3/4	23 7/8	29 7/8
4 C.	24 1/8	27 1/2	42 1/8	37 5/8	30 1/2	33 1/8	35	29 1/2	22 3/4	31	28 7/8	30 3/4
Means	23 1/2	26 1/4	42 3/4	36 1/2	28 5/8	32 5/8	32 5/8	27 3/4	20 3/8	30	26 1/2	29 7/8
1 N.	(15 1/4)	23 1/8	33 3/8	27	19 5/8	24 5/8	20 1/8	18 3/4	16 3/4	27 1/4	24 1/4	30 1/4
2 N.		25 3/8	38 1/4	33 1/4	28 3/4	32	23 5/8	21 1/4	18 5/8	29 5/8	24 1/4	29 7/8
M.				15 1/4	10 5/8	10 3/8	12 3/8	10 7/8	7 1/4	15 1/8	14 1/2	19 1/2
5 O.	(25 1/8)	15 3/4	20 1/4	14 5/8	10 3/8	13 1/4	12 1/2	10 1/2	6 7/8	17 1/2	10 1/2	15 1/4
5 A.	25 1/8	24	35 3/4	31	22 3/4	27 5/8	28 5/8	26 1/8	25 1/2	31 7/8	31 5/8	34
6 {1	17 1/8	16 1/2	22 1/2	18 1/8	9 1/4	16 1/8	12	11 1/4	7 1/2	9 7/8	10 3/8	13 1/2
6 {2	14 1/8	15 7/8	20 3/4	16 3/4	9 1/2	14 5/8	11 3/8	10	7 3/4	10	11 5/8	14 3/8
7	18 1/2	22 3/4	37 1/4	27 1/2	19 3/4	23 5/8	31 3/8	28 1/2	25 3/8	31 5/8	34 1/4	33 1/8

(1) Averages of 4 years, 4 years, and 8 years.

(2) Averages of 9 years (1853–'61), last 10 years,

(4) Averages of 9 years (1853–'61).

MANURE, and with different descriptions of MANURE. Hoos Field, Rothamsted.

(and Chaff) per Acre—Cwts.

at the period indicated, for particulars of which see *Appendix—Table I.*, and side-notes thereto, p. 1C3.]

HARVESTS.								AVERAGE ANNUAL.			
1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.	PLOTS.
Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	
12¾	8⅛	9½	10¼	11⅝	11	6⅝	11	13⅜	10¼	11¾	1 O.
15⅝	9⅛	12⅝	12¼	9⅜	10⅜	8	12¼	14⅞	11⅞	13⅜	2 O.
13⅜	9¾	10¼	10⅛	8⅝	11	8½	11¼	13⅞	10¾	12¼	3 O.
16¾	10	12⅞	12	10⅛	12⅞	9⅜	14	16⅛	12⅝	14⅜	4 O.
14⅝	9¼	11¼	11⅛	9⅞	11¼	8⅛	12⅛	14½	11⅜	12⅞	Means
20⅜	13	15⅜	17¼	12¼	18¼	12½	23⅛	19¾	17⅜	18½	1 A.
32½	21⅝	28⅛	28⅝	19⅜	32	17⅞	28⅛	27⅞	27½	27⅝	2 A.
19¼	16	16¾	19⅜	14⅞	20¾	15	25⅜	21⅞	19¾	20¾	3 A.
34⅞	22½	27⅜	25½	20⅞	34⅜	18⅝	32½	28⅞	28	28½	4 A.
26¾	18¼	21¾	22⅝	16¾	26⅜	16	27¼	24½	23⅛	23¾	Means
23¼	16	17¾	17⅛	14½	21½	17⅞	26¾	24	20⅛	22⅛	1 AA.
33⅛	23	28⅛	30⅞	21⅞	34⅞	23¾	32⅛	31⅞	29⅛	30½	2 AA.
26⅞	17	18⅛	30¾	16¼	22¾	20⅞	25⅜	25¾	23⅛	24⅜	3 AA.
37¼	24⅞	28¼	28⅜	25⅝	38⅛	18¼	32⅝	34¾	30⅛	32⅜	4 AA.
30⅛	20¼	23⅛	26¾	19⅝	29¼	20¼	29¼	29	25⅝	27⅜	Means
26⅛	22⅜	20⅝	18½	16⅞	23¾	17	29¾	(1) 21⅞	21⅞	21⅞ (1)	1 AAS.
33½	23¼	30¼	29½	22	37⅛	20⅛	36⅛	29⅛	28⅞	29	2 AAS.
30¼	20⅜	25	23⅜	25¼	30⅝	20½	31⅛	24¾	26⅞	25⅞	3 AAS.
40¾	25½	29½	28¼	26⅝	42½	20¾	38	31	32	31½	4 AAS.
32⅝	22⅞	26⅜	24⅞	22⅝	33½	19⅝	33¾	26⅝	27⅜	27	Means
26⅛	21½	24⅛	25½	19⅛	27	17¼	27½	29⅜	24¼	26⅞	1 C.
31⅞	21⅞	24½	25⅝	19⅝	33⅛	17⅞	27⅞	30⅞	26	28⅜	2 C.
31	22	24⅜	22¼	19¾	30½	18⅜	30⅞	28⅞	25¼	27⅛	3 C.
34⅞	22	27⅝	24¼	21⅛	35⅛	20⅜	32	31¼	27¾	29½	4 C.
31	21⅞	25⅛	24⅜	19⅞	31⅜	18½	29⅝	30⅛	25¾	28	Means
24⅛	18½	21⅛	21⅛	18⅞	24	13¼	29¼	(2) 23⅜	22½	22⅞ (2)	1 N.
27¾	21½	23⅞	21¾	17⅛	27⅝	19⅛	31½	27⅞	24½	26⅛	2 N.
13⅞	9⅜	12⅜	12	10⅞	11⅝	8⅞	14¾	(3)(11¾	12¾	12⅜) (3)	M.
14⅞	10¾	10⅝	10⅜	8½	15½	4⅜	13⅛	(4)(13⅝	11⅜	12⅜) (4)	5 O.
33⅞	24⅞	28	22⅜	20⅝	36⅛	21⅜	29⅝	27⅞	28¼	28	5 A.
13⅝	8¾	10½	9⅝	10½	9⅞	7¾	13	14	10¾	12⅜	1} 6
13⅞	8⅞	9½	10⅞	10⅞	10⅜	7⅞	13⅝	13	11¼	12⅛	2} 6
37⅜	25⅜	31½	27⅛	24½	28¾	19¾	37⅛	26⅝	29⅞	28¼	7

and total 19 years. (3) Averages of 7 years (1855–'61), last 10 years, and total 17 years.
last 10 years, and total 19 years.

EXPERIMENTS on the GROWTH of BARLEY year after year on the same LAND, without

APPENDIX—TABLE VII. Total Produce

[N.B. The double vertical lines show that there was a change in the description, or quantity, of Manure,

PLOTS.	HARVESTS.											
	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1 O.	3445	3562	4405	3745	1797	2878	2424	1800	1598	2166	1987	2545
2 O.	3459	3783	4898	3955	1865	3606	3327	2559	1877	2900	2701	3569
3 O.	3405	3521	4353	3873	1961	3426	2771	1962	1802	2369	2309	3050
4 O.	4008	4312	4969	4082	2075	4111	3590	2567	2093	3366	2941	3596
Means	3579	3794	4656	3914	1924	3505	3028	2222	1842	2700	2484	3190
1 A.	4652	4950	6155	5148	3347	4118	3506	2204	3166	3945	4106	4806
2 A.	5127	5202	8017	5929	3874	6161	6099	4814	5196	6411	6416	7319
3 A.	4730	5079	6672	5579	3574	4702	3951	2487	3355	4212	4658	5691
4 A.	5487	5284	7958	6134	3981	6336	6192	5067	5355	6472	6273	6791
Means	4999	5129	7200	5697	3694	5329	4937	3643	4268	5260	5363	6152
1 AA.	5490	5324	7548	6242	4801	5360	4345	2857	2905	4449	4247	5561
2 AA.	5662	5615	8619	7027	5233	7383	6791	5105	5053	6721	6443	7148
3 AA.	5378	5405	7315	6388	4414	5618	4791	3035	3702	4743	5003	6168
4 AA.	5714	6134	9026	7054	5582	7734	7160	5517	5746	6937	6529	7323
Means	5561	5619	8127	6678	5008	6524	5772	4128	4352	5713	5556	6550
1 AAS.												
2 AAS.												
3 AAS.												
4 AAS.												
Means												
1 C.	4949	5323	8238	6720	4780	7262	6425	5260	3771	6332	5299	6214
2 C.	4713	5110	8388	6904	5447	7266	6964	5509	4356	6625	5669	6593
3 C.	4351	4943	7848	6676	4673	6877	6337	4866	4198	6392	4786	6429
4 C.	4796	5386	8125	6993	5257	7241	7082	5440	4783	6576	5872	6599
Means	4702	5190	8150	6823	5039	7161	6702	5269	4277	6481	5407	6459
1 N.	(3143)	4631	6475	5757	3877	5389	4399	3500	3416	5260	4793	6265
2 N.		4906	7400	6416	5450	6816	5125	3905	3793	5665	4959	6366
M.				3440	2206	2538	2856	2275	1433	3263	3061	3740
5 O.	(4843)	3263	4013	3394	2169	3254	2846	2125	1363	3563	2266	3354
5 A.	4843	4996	6964	6066	4247	6161	5954	4777	5038	6373	6175	6749
6 {1	3550	3371	4519	4100	1952	3711	2846	2212	1560	2048	2189	3042
6 {2	3030	3336	4221	3857	1981	3375	2693	1948	1581	2117	2480	3221
7	3920	4682	7298	5852	3866	5564	6635	5558	5156	6715	6774	7185

(1) Averages of 4 years, 4 years, and 8 years. (2) Averages of 9 years (1853–'61), last 10 years,

(4) Averages of 9 years (1853–'61),

MANURE, and with different descriptions of MANURE. Hoos Field, Rothamsted.

(Corn, Straw and Chaff) per Acre—lbs.

at the period indicated, for particulars of which see *Appendix—Table I.*, and side-notes thereto, p. 163.

HARVESTS.								AVERAGE ANNUAL.			
1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.	PLOTS.
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
2809	1924	1928	2124	2173	2075	1489	2208	2782	2126	2454	1 O.
3533	2268	2636	2759	2110	2238	1884	2694	3223	2639	2931	2 O.
3020	2325	2191	2098	1789	2333	1882	2380	2944	2338	2641	3 O.
3829	2464	2759	2526	2126	2729	2101	3002	3517	2807	3162	4 O.
3298	2245	2378	2377	2049	2344	1839	2571	3116	2478	2797	Means
4533	3127	3200	3611	2507	3640	2945	4712	4119	3719	3919	1 A.
7042	5061	5955	5658	4255	6430	4412	5820	5683	5837	5760	2 A.
4726	3658	3412	3977	3074	4319	3406	5080	4434	4200	4317	3 A.
7225	5075	5704	5304	4311	6701	4287	6404	5827	5808	5817	4 A.
5881	4230	4568	4637	3537	5272	3762	5504	5016	4891	4953	Means
5040	3668	3628	3589	3130	4181	3628	5250	4932	4192	4562	1 AA.
7008	5180	6068	5917	4937	6750	5315	6371	6321	6114	6217	2 AA.
5613	3820	3661	5264	3401	4477	4141	4933	4648	5079	4864	3 AA.
7469	5469	6117	5753	5454	7194	4621	6333	6660	6226	6443	4 AA.
6282	4534	4869	5131	4231	5651	4426	5722	5640	5403	5522	Means
5501	4453	4357	3884	3537	4689	3868	6051	(1) 4549	4536	4543 (1)	1 AAS.
6945	5172	6327	5790	4524	7082	4851	6954	(1) 6059	5853	5956 (1)	2 AAS.
6316	4582	5144	4793	5410	5864	4724	6221	(1) 5209	5555	5382 (1)	3 AAS.
8025	5609	6198	5708	5644	7881	5073	7146	(1) 6385	6436	6411 (1)	4 AAS.
6697	4954	5507	5044	4779	6379	4629	6594	5551	5595	5573	Means
5758	4909	5337	5064	4267	5512	4358	5637	5906	5236	5571	1 C.
6604	4959	5487	5460	4238	6571	4437	5570	6128	5559	5844	2 C.
6396	5134	5242	4711	4213	5993	4324	6153	5716	5338	5527	3 C.
7061	5117	5929	5121	4414	7001	4857	6394	6168	5837	6002	4 C.
6455	5030	5499	5089	4283	6269	4494	5939	5980	5493	5736	Means
5065	4174	4275	4234	3530	4759	3456	5726	(2) 4745	4628	4683 (2)	1 N.
5820	4629	4941	4438	3366	5313	4413	6175	(2) 5497	5042	5258 (2)	2 N.
3079	2195	2436	2499	2044	2265	1903	2920	(3)(2573	2614	2597)(3)	M.
3273	2490	2443	2271	1826	3111	1323	2618	(4)(2888	2498	2682)(4)	5 O.
6815	5490	5591	4511	4119	6979	4817	5927	5542	5747	5644	5 A.
2986	2159	2078	2026	2019	1957	1720	2554	2987	2273	2630	1 } 6
3008	2076	2017	2344	2097	2031	1740	2896	2814	2391	2603	2 } 6
7852	5769	6594	5652	5281	5959	4950	7401	5525	6342	5933	7

and total 19 years. (3) Averages of 7 years (1855–'61), last 10 years, and total 17 years.
last 10 years, and total 19 years.

EXPERIMENTS on the GROWTH of BARLEY year after year on the same LAND, without

APPENDIX—TABLE VIII. Increase by Manure (over the

[N.B. The double vertical lines show that there was a change in the description, or quantity, of Manure

PLOTS.	HARVESTS. 1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1 O.												
2 O.	− 1	330	317	49	25	185	305	314	148	470	288	412
3 O.	−48	49	40	− 6	75	65	44	7	111	144	129	155
4 O.	213	480	393	143	157	515	428	332	277	708	463	466
Means	55	286	250	62	86	255	259	218	179	441	293	344
1 A.	482	748	782	519	571	457	419	54	765	805	856	1004
2 A.	606	815	1456	715	606	1485	1527	1169	1635	2133	1826	2109
3 A.	485	722	916	580	716	626	594	112	804	859	1084	1346
4 A.	762	772	1447	735	738	1540	1545	1152	1639	2119	1760	1808
Means	584	764	1150	637	658	1027	1021	622	1211	1479	1382	1567
1 AA.	880	857	1332	716	1200	1049	846	372	659	1046	909	1351
2 AA.	877	898	1662	783	826	2020	1779	1275	1602	2238	1943	2113
3 AA.	825	821	1094	662	628	1032	959	370	936	1098	1269	1640
4 AA.	926	1053	1558	658	1025	2001	1803	1227	1765	2229	1859	2027
Means	877	907	1412	705	920	1526	1347	811	1241	1653	1495	1783
1 AAS.												
2 AAS.												
3 AAS.												
4 AAS.												
Means												
1 C.	587	781	1407	744	1009	1871	1628	1380	1037	2269	1424	1603
2 C.	451	706	1463	933	1055	1845	1822	1419	1315	2287	1654	1811
3 C.	301	576	1240	735	850	1741	1535	1136	1207	2004	1153	1687
4 C.	492	765	1432	859	980	1860	1810	1270	1502	2171	1669	1757
Means	458	707	1386	818	974	1829	1699	1301	1265	2183	1475	1715
1 N. }	- (169) {	507	759	803	814	958	792	535	810	1275	1110	1473
2 N. }		534	1132	772	1364	1550	1128	660	967	1405	1219	1614
M.				− 194	155	− 297	124	190	− 118	623	478	160
5 O.	(428)	− 44	− 233	− 165	148	88	89	90	− 143	658	123	239
5 A.	428	769	978	672	839	1385	1402	992	1452	1868	1670	1542
6 {1, 2	− 155	18	− 77	58	62	62	70	− 34	− 18	60	217	211
7	238	599	1146	841	795	1239	1766	1497	1583	2229	1971	2071

(1) Averages of 4 years, 4 years, and 8 years.

(2) Averages of 9 years (1853–'61), last 10 years,

(4) Averages of 9 years (1853–'61),

MANURE, and with different descriptions of MANURE. Hoos Field, Rothamsted.

Mean of Plots 1 O. and 6–1), of Total Corn, per Acre—lbs.

at the period indicated, for particulars of which see *Appendix—Table I.*, and side-notes thereto, p. 163.]

HARVESTS.								AVERAGE ANNUAL.			PLOTS.
1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.	
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
											1 O.
370	153	337	420	200	230	185	297	214	289	252	2 O.
106	138	162	– 4	– 36	248	127	93	48	112	80	3 O.
529	250	444	214	138	437	252	406	365	360	363	4 O.
335	180	314	210	101	305	188	265	209	254	232	Means
838	567	595	720	276	750	738	1097	560	744	652	1 A.
1979	1537	1930	1492	1232	2000	1603	1640	1215	1735	1475	2 A.
1143	773	662	842	546	1145	932	1199	641	967	804	3 A.
1896	1450	1757	1488	1118	1999	1396	1737	1245	1641	1443	4 A.
1464	1082	1236	1136	793	1474	1167	1418	915	1272	1094	Means
1010	776	754	703	640	924	829	1218	896	911	904	1 AA.
1880	1501	2034	1498	1632	1996	1854	1739	1396	1819	1608	2 AA.
1180	821	752	848	718	1080	1001	1066	843	1038	941	3 AA.
1879	1585	2075	1607	1726	2080	1770	1651	1425	1826	1625	4 AA.
1487	1171	1404	1164	1179	1520	1364	1419	1140	1399	1270	Means
1153	849	1175	845	784	1180	1162	1689	[1] 1006	1204	1105 [1]	1 AAS.
1770	1465	2060	1524	1201	2075	1792	1872	[1] 1705	1735	1720 [1]	2 AAS.
1513	1200	1462	1207	1725	1580	1623	1699	[1] 1346	1657	1501 [1]	3 AAS.
2045	1652	2009	1577	1809	2269	1954	1854	[1] 1821	1972	1896 [1]	4 AAS.
1620	1292	1677	1288	1380	1776	1633	1779	1470	1642	1556	Means
1408	1409	1752	1243	1262	1633	1628	1529	1271	1489	1380	1 C.
1619	1404	1862	1628	1184	2018	1636	1413	1330	1623	1477	2 C.
1503	1567	1639	1255	1139	1735	1459	1663	1133	1480	1307	3 C.
1733	1549	1955	1445	1191	2216	1768	1777	1314	1706	1510	4 C.
1566	1482	1802	1393	1194	1901	1623	1596	1262	1575	1419	Means
940	1002	1031	900	550	1215	1165	1419	[2] 806	1081	950 [2]	1 N.
1290	1127	1387	1042	583	1369	1477	1618	[2] 1057	1273	1170 [2]	2 N.
99	46	169	195	– 39	108	114	243	[3] (69	157	121) [3]	M.
190	191	369	145	8	529	34	111	[4] (54	194	128) [4]	5 O.
1595	1611	1582	1035	1254	2082	1623	1572	1079	1557	1318	5 A.
34	– 15	69	155	16	24	52	343	5	111	58	1, 2 } 6
2252	1824	2186	1648	1679	1897	1933	2211	1193	1967	1580	7

and total 19 years. (3) Averages of 7 years (1855–'61), last 10 years, and total 17 years.
last 10 years, and total 19 years.

EXPERIMENTS on the GROWTH of BARLEY year after year on the same LAND, without

APPENDIX—TABLE IX. Increase by Manure (over the Mean

[N.B. The double vertical lines show that there was a change in the description, or quantity, of Manure,

PLOTS.	HARVESTS.											
	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1 O.												
2 O.	– 38	- 14	118	– 17	– 35	126	386	238	150	323	325	363
3 O.	– 45	5	–150	– 44	11	66	91	- 52	112	118	92	101
4 O.	297	365	113	16	43	301	526	228	237	551	390	336
Means	71	119	27	– 15	6	164	334	138	166	331	269	267
1 A.	672	735	910	706	901	366	451	143	822	1033	1162	1008
2 A.	1023	920	2098	1291	1393	1381	1936	1638	1982	2171	2502	2416
3 A.	747	890	1293	1076	983	781	721	368	972	1246	1486	1551
4 A.	1227	1045	2048	1476	1368	1501	2011	1908	2137	2246	2425	2189
Means	917	898	1587	1137	1161	1007	1280	1014	1478	1674	1894	1791
1 AA.	1112	1000	1753	1603	1726	1016	863	478	667	1296	1250	1416
2 AA.	1287	1250	2494	2321	2532	2068	2376	1823	1872	2376	2412	2241
3 AA.	1055	1117	1758	1803	1911	1291	1196	658	1187	1538	1646	1734
4 AA.	1290	1614	3065	2473	2682	2438	2721	2283	2402	2601	2582	2502
Means.	1186	1245	2253	2050	2213	1703	1789	1311	1532	1953	1973	1973
1 AAS.												
2 AAS.												
3 AAS.												
4 AAS.												
Means												
1 C.	864	1075	2368	2053	1896	2096	2161	1873	1155	1956	1787	1817
2 C.	764	937	2462	2048	2517	2126	2506	2083	1462	2231	1927	1988
3 C.	552	900	2145	2018	1948	1841	2166	1723	1412	2281	1545	1948
4 C.	806	1154	2230	2211	2402	2086	2636	2163	1702	2298	2115	2048
Means	747	1017	2301	2083	2191	2037	2367	1961	1433	2192	1844	1950
1 N.	(– 186)	657	1253	1031	1188	1136	971	958	1027	1878	1595	1998
2 N.		905	1805	1721	2211	1971	1361	1238	1247	2153	1652	1958
M.				–289	176	–460	96	78	- 28	533	495	786
5 O.	(917)	–160	- 217	- 364	146	–129	121	28	– 73	798	55	321
5 A.	917	760	1523	1471	1533	1481	1916	1778	2007	2398	2417	2413
6 {1, 2	– 313	–149	-165	- 124	44	18	- 13	- 25	20	– 50	175	216
7	184	616	1689	1088	1196	1030	2233	2054	1994	2379	2715	2320

(1) Averages of 4 years, 4 years, and 8 years.

(2) Averages of 9 years (1853–'61), last 10 years,

(4) Averages of 9 years (1853–'61),

MANURE, and with different descriptions of MANURE. Hoos Field, Rothamsted.

of Plots 1 O and 6–1), of Straw (and Chaff) per Acre—lbs.

at the period indicated, for particulars of which see *Appendix—Table 1.*, and side-notes thereto, p. 163.

HARVESTS.								AVERAGE ANNUAL.			PLOTS.
1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.	
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	1 O.
265	73	295	263	-186	— 9	94	16	124	150	137	2 O.
16	145	25	26	-271	68	150	— 94	11	26	19	3 O.
402	172	311	236	-108	275	244	215	268	248	258	4 O.
228	130	210	175	-188	111	163	46	134	141	138	Means
797	518	601	815	135	873	602	1234	674	775	724	1 A.
2165	1482	2021	2090	927	2413	1204	1799	1583	1902	1742	2 A.
685	843	746	1059	432	1157	869	1500	908	1033	970	3 A.
2431	1583	1943	1740	1097	2685	1286	2286	1697	1967	1832	4 A.
1520	1107	1328	1426	648	1782	990	1705	1215	1419	1317	Means
1132	850	870	810	394	1240	1194	1651	1151	1081	1116	1 AA.
2230	1637	2030	2343	1209	2737	1856	2251	2040	2095	2067	2 AA.
1535	957	905	2340	587	1380	1534	1486	1351	1410	1380	3 AA.
2692	1842	2038	2070	1632	3097	1246	2301	2351	2200	2276	4 AA.
1897	1322	1461	1891	956	2114	1458	1922	1723	1697	1710	Means
1450	1562	1178	963	657	1492	1101	1981	(1) 1288	1308	1298 (1)	1 AAS.
2277	1665	2263	2190	1227	2990	1454	2701	(1) 2099	2093	2096 (1)	2 AAS.
1905	1340	1678	1510	1589	2267	1496	2141	(1) 1608	1873	1741 (1)	3 AAS.
3082	1915	2185	2055	1739	3595	1514	2911	(1) 2309	2440	2275 (1)	4 AAS.
2179	1621	1826	1680	1303	2586	1391	2434	1826	1929	1877	Means
1452	1458	1581	1745	909	1862	1125	1727	1750	1546	1648	1 C.
2087	1513	1621	1756	958	2536	1196	1776	1914	1736	1825	2 C.
1995	1525	1599	1380	978	2241	1260	2109	1699	1658	1678	3 C.
2430	1526	1970	1600	1127	2768	1484	2236	1969	1930	1950	4 C.
1991	1506	1693	1620	993	2352	1266	1962	1833	1718	1775	Means
1227	1130	1240	1258	884	1527	686	1926	(2) 1122	1347	1241 (2)	1 N.
1632	1460	1550	1320	687	1927	1331	2176	(2) 1624	1569	1595 (2)	2 N.
82	107	263	228	13	140	184	296	(3) (15	257	157)(3)	M.
185	257	70	50	—278	565	- 316	126	(4) (17	104	62)(4)	5 O.
2322	1837	2005	1400	1069	2880	1589	1974	1578	1991	1784	5 A.
76	49	— 56	113	— 15	— 10	83	172	- 76	80	2	1, 2 } 6
2702	1903	2404	1928	1506	2045	1412	2809	1447	2174	1811	7

nd total 19 years. (3) Averages of 7 years (1855–'61), last 10 years, and total 17 years.

ist 10 years, and total 19 years.

EXPERIMENTS on the GROWTH of BARLEY year after year on the same LAND, without

APPENDIX—TABLE X. Increase by Manure (over the Mean of Plots 1 O

[N.B. The double vertical lines show that there was a change in the description, or quantity, of Manure,

PLOTS.	HARVESTS. 1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1 O.												
2 O.	− 39	316	435	32	− 10	311	691	552	298	793	613	775
3 O.	− 93	54	−110	− 50	86	131	135	− 45	223	262	221	256
4 O.	510	845	506	159	200	816	954	560	514	1259	853	802
Means	126	405	277	47	92	419	593	356	345	771	562	611
1 A.	1154	1483	1692	1225	1472	823	870	197	1587	1838	2018	2012
2 A.	1629	1735	3554	2006	1999	2866	3463	2807	3617	4304	4328	4525
3 A.	1232	1612	2209	1656	1699	1407	1315	480	1776	2105	2570	2897
4 A.	1989	1817	3495	2211	2106	3041	3556	3060	3776	4365	4185	3997
Means	1501	1662	2738	1775	1819	2034	2301	1636	2689	3153	3275	3358
1 AA.	1992	1857	3085	2319	2926	2065	1709	850	1326	2342	2159	2767
2 AA.	2164	2148	4156	3104	3358	4088	4155	3098	3474	4614	4355	4354
3 AA.	1880	1938	2852	2465	2539	2323	2155	1028	2123	2636	2915	3374
4 AA.	2216	2667	4563	3131	3707	4439	4524	3510	4167	4830	4441	4529
Means	2063	2153	3664	2755	3133	3229	3136	2122	2773	3606	3468	3756
1 AAS.												
2 AAS.												
3 AAS.												
4 AAS.												
Means												
1 C.	1451	1856	3775	2797	2905	3967	3789	3253	2192	4225	3211	3420
2 C.	1215	1643	3925	2981	3572	3971	4328	3502	2777	4518	3581	3799
3 C.	853	1476	3385	2753	2798	3582	3701	2859	2619	4285	2698	3635
4 C.	1298	1919	3662	3070	3382	3946	4446	3433	3204	4469	3784	3805
Means	1204	1724	3687	2900	3164	3867	4066	3262	2698	4374	3319	3665
1 N.	(− 355)	1164	2012	1834	2002	2094	1763	1493	1837	3153	2705	3471
2 N.		1439	2937	2493	3575	3521	2489	1898	2214	3558	2871	3572
M.				−483	331	−757	220	268	−146	1156	973	946
5 O.	(1345)	− 204	− 450	− 529	294	− 41	210	118	− 216	1456	178	560
5 A.	1345	1529	2501	2143	2372	2866	3318	2770	3459	4266	4087	3955
6 {1, 2}	−468	− 131	− 242	− 66	106	80	57	− 59	2	10	392	427
7	422	1215	2835	1929	1991	2269	3999	3551	3577	4608	4686	4391

(1) Averages of 4 years, 4 years, and 8 years.

(2) Averages of 9 years (1853–'61), last 10 yea

(4) Averages of 9 years (1853–'61

MANURE, and with different descriptions of MANURE. Hoos Field, Rothamsted.

and 6–1), of total produce (Corn, Straw, and Chaff) per Acre—lbs.

at the period indicated, for particulars of which see *Appendix—Table I.*, and side-notes thereto, p. 163.]

HARVESTS.								AVERAGE ANNUAL.			PLOTS.
1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.	
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	1 O.
635	226	632	683	14	221	279	313	338	439	389	2 O.
122	283	187	22	-307	316	277	- 1	59	138	99	3 O.
931	422	755	450	30	712	496	621	632	607	621	4 O.
563	310	525	385	- 88	416	351	311	343	395	370	Means
1635	1085	1196	1535	411	1623	1340	2331	1234	1519	1376	1 A.
4144	3019	3951	3582	2159	4413	2807	3439	2798	3637	3217	2 A.
1828	1616	1408	1901	978	2302	1801	2699	1549	2000	1774	3 A.
4327	3033	3700	3228	2215	4684	2682	4023	2942	3608	3275	4 A.
2984	2188	2564	2562	1441	3256	2158	3123	2130	2691	2411	Means
2142	1626	1624	1513	1034	2164	2023	2869	2047	1992	2020	1 AA.
4110	3138	4064	3841	2841	4733	3710	3990	3436	3914	3675	2 AA.
2715	1778	1657	3188	1305	2460	2535	2552	2194	2448	2321	3 AA.
4571	3427	4113	3677	3358	5177	3016	3952	3776	4026	3901	4 AA.
3385	2492	2865	3055	2135	3634	2821	3341	2863	3096	2980	Means
2603	2411	2553	1808	1441	2672	2263	3670	(1) 2294	2512	2403 (1)	1 AAS.
4047	3130	4323	3714	2428	5065	3246	4573	3804	3828	3816	2 AAS.
3418	2540	3140	2717	3314	3847	3119	3840	2954	3530	3242	3 AAS.
5127	3567	4194	3632	3548	5864	3468	4765	4130	4412	4271	4 AAS.
3799	2912	3503	2968	2683	4362	3024	4212	3296	3571	3433	Means
2860	2867	3333	2988	2171	3495	2753	3256	3021	3035	3028	1 C.
3706	2917	3483	3384	2142	4554	2832	3189	3244	3359	3302	2 C.
3498	3092	3238	2635	2117	3976	2719	3772	2832	3138	2985	3 C.
4163	3075	3925	3045	2318	4984	3252	4013	3283	3636	3460	4 C.
3557	2988	3495	3013	2187	4252	2889	3558	3095	3293	3194	Means
2167	2132	2271	2158	1434	2742	1851	3345	(2) 1928	2428	2191 (2)	1 N.
2922	2587	2937	2362	1270	3296	2808	3794	2681	2842	2765	2 N.
181	153	432	423	- 52	248	298	539	(3) (84	414	278)(3)	M.
375	448	439	195	-270	1094	-282	237	(4) (71	298	190)(4)	5 O.
3917	3448	3587	2435	2323	4962	3212	3546	2657	3548	3102	5 A.
110	34	13	268	1	14	135	515	- 71	191	60	1, 2 } 6
4954	3727	4590	3576	3185	3942	3345	5020	2640	4141	3391	7

and total 19 years. (3) Averages of 7 years (1855–'61), last 10 years, and total 17 years.

last 10 years, and total 19 years.

Experiments on the Growth of Barley year after year on the same Land, without

APPENDIX—Table XI. Offal

[N.B. The double vertical lines show that there was a change in the description, or quantity, of Manure,

PLOTS.	HARVESTS.											
	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.
1 O.	11·5	17·0	4·5	8·9	19·3	6·9	7·7	16·5	11·6	10·3	7·6	4·0
2 O.	6·6	5·7	4·6	3·6	7·0	6·1	6·6	15·6	10·6	5·8	10·0	3·3
3 O.	13·3	10·5	3·3	4·1	15·9	3·6	7·4	10·8	10·2	8·8	7·2	3·6
4 O.	8·1	8·6	4·6	4·8	9·5	2·5	6·4	15·4	7·9	3·6	8·9	3·1
Means	9·9	10·5	4·3	5·3	12·9	4·8	7·0	14·6	10·1	7·1	8·4	3·5
1 A.	11·6	12·5	7·9	6·0	18·1	5·6	5·9	25·0	11·1	10·8	17·3	5·1
2 A.	13·3	11·1	4·6	7·5	9·0	2·9	4·1	15·6	7·2	4·4	7·4	2·9
3 A.	13·7	17·5	7·3	7·6	12·9	4·1	5·2	21·8	8·1	6·4	15·1	4·1
4 A.	13·0	13·5	4·2	5·6	8·5	2·2	4·2	14·3	6·7	3·7	5·8	2·6
Means	12·9	13·7	6·0	6·7	12·1	3·7	4·8	19·2	8·3	6·3	11·4	3·7
1 AA.	13·7	14·5	10·9	8·4	17·7	5·2	4·2	21·0	8 5	9·5	18·8	4·2
2 AA.	14·5	11·5	9·9	7·2	16·0	3·7	4·5	17·6	5·3	6·4	4·8	4·2
3 AA.	15·0	11·1	12·2	8·9	24·2	4·2	5·4	27·3	7·9	7·2	19·5	3·2
4 AA.	10·8	13·2	8·3	6·2	10·3	5·2	4·7	15·8	6·0	6·0	7·3	2·0
Means	13·5	12·6	10·3	7·7	17·1	4·6	4·7	20·4	6·9	7·3	12·6	3·4
1 AAS.												
2 AAS.												
3 AAS.												
4 AAS.												
Means												
1 C.	8·4	13·0	5·5	8·9	10·2	4·0	3·6	11·1	7·3	5·0	6·9	2·9
2 C.	8·7	20·2	7·4	7·3	9·2	5·1	4·9	8·1	8·3	4·9	5·1	3·5
3 C.	11 1	16·3	8·3	7·4	12·4	4·8	3·8	13·4	6·3	7·4	9·9	2·3
4 C.	7·4	13·7	7·1	8·7	12·5	5·0	4·1	19·6	7·3	7·0	7·1	2·1
Means	8·9	15·8	7·1	8·1	11·1	4·7	4·1	13·1	7·3	6·1	7·2	2·7
1 N.	(7·0)	16·0	4·1	4·9	17·1	3·9	5·9	17·2	10·5	11·3	13·4	4·4
2 N.		12·3	10·1	9·1	9·5	4·9	4·6	18·2	11·7	8·8	11·0	3·9
M.				2·1	10·2	7·0	6·0	8·8	13·8	5·2	15·9	3·1
5 O.	(9·3)	4·8	6·9	2·9	10·6	6·1	5·2	13·0	13·9	4·8	21·5	2·6
5 A.	9·3	10·0	6·1	5·1	9·8	2·3	5·9	9·9	9·7	7·2	8·7	2·8
6 {1	7·9	15·1	7·8	5·9	20·1	3·9	6·0	14·5	13·9	8·4	7·8	3·5
6 {2	8·8	11·6	6·7	3·8	15·7	6·4	6·1	18·0	15·2	7·1	19·6	4·2
7	5·8	14·4	2·8	4·1	9·3	4·8	4·0	12·4	6·8	6·4	7·6	1·9

(1) Averages of 4 years, 4 years, and 8 years.

(2) Averages of 9 years (1853–'61), last 10 years,

(4) Averages of 9 years (1853–'61),

Manure, and with different descriptions of Manure. Hoos Field, Rothamsted.

;orn to 100 Dressed Corn.

.t the period indicated, for particulars of which see *Appendix—Table I.*, and side-notes thereto, p. 163.]

HARVESTS.								AVERAGE ANNUAL.			
1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.	PLOTS.
3·1	4·8	5·1	10·1	2·4	5·5	4·3	5·2	11·4	5·2	8·3	1 O.
4·0	3·1	1·7	3·9	2·8	9·0	1·9	2·6	7·2	4·2	5·8	2 O.
2·9	3·2	3·8	7·1	3·4	6·8	2·0	3·2	8·8	4·3	6·6	3 O.
2·2	2·1	4·3	5·4	2·6	5·7	2·5	3·4	7·1	4·0	5·6	4 O.
3·1	3·3	3·7	6·6	2·8	6·8	2·7	3·6	8·6	4·4	6·5	Means
4·6	3·6	6·8	7·3	4·5	9·6	1·5	5·2	11·5	6·6	9·0	1 A.
1·9	3·3	2·3	3·2	1·8	4·1	1·1	7·6	8·0	3·6	5·8	2 A.
3·4	2·8	7·4	5·5	2·5	5·0	1·4	4·1	10·5	5·1	7·8	3 A.
3·4	2·4	2·5	3·0	2·6	0·8	1·2	5·6	7·6	3·0	5·3	4 A.
3·3	3·0	4·8	4·8	2·9	4·9	1·3	5·6	9·4	4·6	7·0	Means
4·7	3·5	9·9	7·1	3·2	3·7	2·0	6·3	11·4	6·3	8·9	1 AA.
1·5	4·5	4·0	2·9	1·9	3·2	0·9	6·4	9·7	3·4	6·5	2 AA.
3·0	2·5	6·7	6·2	3·9	6·1	2·1	6·7	12·3	6·0	9·2	3 AA.
1·4	2·9	4·7	4·8	1·7	2·7	1·2	3·5	8·6	3·2	6·0	4 AA.
2·7	3·4	6·3	5·3	2·7	4·0	1·5	5·7	10·5	4·7	7·6	Means
3·8	2·9	4·5	4·9	3·1	6·4	1·7	3·6	(1) 4·0	3·7	3·9 (1)	1 AAS.
1·7	3·5	3·4	2·7	1·9	2·1	0·9	5·5	2·8	2·6	2·7	2 AAS.
2·5	2·2	6·4	3·8	2·5	5·9	1·2	5·0	3·7	3·6	3·7	3 AAS.
2·7	2·6	2·9	3·8	1·8	4·2	1·0	6·5	3·0	3·4	3·2	4 AAS.
2·7	2·8	4·3	3·8	2·3	4·7	1·2	5·1	3·4	3·3	3·4	Means
2·8	3·4	4·1	5·2	2·1	2·9	1·0	3·2	7·7	3·5	5·6	1 C.
3·1	1·8	3·4	3·6	3·2	4·0	1·0	3·7	8·4	3·2	5·8	2 C.
3·2	2·6	3·9	4·3	2·0	3·7	1·7	5·5	9·1	3·9	6·5	3 C.
4·0	2·7	4·7	3·1	2·1	2·2	1·1	4·6	9·2	3·4	6·3	4 C.
3·3	2·6	4·0	4·0	2·3	3·2	1·2	4·3	8·6	3·5	6·1	Means
3·2	4·9	6·9	6·8	4·5	7·8	1·7	4·2	(2) 10·1	5·7	7·8 (2)	1 N.
3·6	3·9	4·8	4·6	2·5	4·6	1·5	6·9	9·9	4·7	7·1	2 N.
3·9	6·4	4·4	5·1	3·3	6·8	2·8	4·7	(3) (7·6	5·6	6·4) (3)	M.
5·1	2·8	4·0	5·3	2·4	5·8	2·8	3·8	(4) (7·6	5·6	6·5) (4)	5 O.
3·1	3·6	2·2	3·8	1·6	2·2	1·3	5·8	7·5	3·5	5·5	5 A.
3·6	4·0	8·7	12·1	3·3	9·0	3·2	4·8	10·4	6·0	8·2	1 } 6
3·9	4·5	5·7	8·0	2·4	7·0	2·8	3·0	9·9	6·1	8·0	2 } 6
3·3	2·0	5·1	4·5	1·9	3·8	1·0	5·6	7·1	3·7	5·4	7

l total 19 years. (3) Averages of 7 years (1855–'61), last 10 years, and total 17 years.
t 10 years, and total 19 years.

EXPERIMENTS on the GROWTH of BARLEY year after year on the same LAND, without

APPENDIX—TABLE XII. Total

[N.B. The double vertical lines show that there was a change in the description, or quantity, of Manure,

PLOTS.	HARVESTS. 1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.
1 O.	85	77	80	90	82	102	99	76	89	77	83	101
2 O.	87	97	88	99	90	107	99	85	89	95	87	103
3 O.	84	82	87	98	91	103	102	80	89	84	90	104
4 O.	83	88	92	103	96	114	98	87	94	96	94	108
Means	85	86	87	97	90	106	99	82	90	88	88	104
1 A.	81	86	81	90	75	107	102	72	90	79	80	100
2 A.	76	83	75	80	61	105	89	73	84	92	77	92
3 A.	79	80	77	81	79	96	97	65	85	75	79	93
4 A.	76	78	76	77	67	103	88	66	80	90	77	90
Means	78	82	77	82	70	103	94	69	85	84	78	94
1 AA.	83	82	78	73	75	103	102	76	92	81	79	98
2 AA.	78	77	73	63	48	100	86	72	86	90	82	97
3 AA.	82	77	73	68	51	93	93	69	82	75	81	97
4 AA.	80	73	65	58	51	91	79	61	77	84	76	88
Means	81	77	72	65	56	97	90	70	84	83	80	95
1 AAS.												
2 AAS.												
3 AAS.												
4 AAS.												
Means												
1 C.	80	77	70	66	64	95	87	74	89	103	82	94
2 C.	77	78	70	71	54	94	84	71	89	95	86	95
3 C.	78	75	70	66	58	99	84	70	86	85	79	92
4 C.	78	75	72	66	54	95	81	65	88	90	81	92
Means	78	76	70	67	58	96	84	70	88	93	82	93
1 N.	(84)	79	73	90	76	96	95	67	83	73	76	85
2 N.		73	73	72	69	90	94	64	81	71	79	90
M.				101	85	119	107	86	76	92	89	72
5 O.	(72)	84	77	108	87	118	103	82	77	81	92	96
5 A.	72	86	74	75	67	99	86	64	77	79	74	77
6 {1	85	82	79	102	87	105	111	76	85	85	89	101
6 {2	92	87	82	106	87	106	112	74	83	90	91	100
7	89	84	75	90	75	110	89	74	82	89	77	94

(1) Averages of 4 years, 4 years, and 8 years.

(2) Averages of 9 years (1853–'61), last 10 year

(4) Averages of 9 years (1853–'61

Lanure, and with different descriptions of Manure. Hoos Field, Rothamsted.

orn to 100 Straw (and Chaff).

t the period indicated, for particulars of which see *Appendix—Table I.*, and side-notes thereto, p. 163.]

HARVESTS.								AVERAGE ANNUAL.			PLOTS.
1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.	
96	112	80	85	67	68	102	79	86	87	87	1 O.
103	123	86	101	101	93	110	97	94	100	97	2 O.
102	114	91	85	85	89	97	90	90	95	92	3 O.
104	121	92	88	89	89	101	92	95	98	96	4 O.
101	117	87	90	85	85	102	89	91	95	93	Means
99	114	85	88	83	78	109	82	86	92	89	1 A.
93	109	89	77	97	80	120	85	82	92	87	2 A.
119	105	82	83	84	86	104	78	81	91	86	3 A.
85	101	86	86	85	74	105	76	80	86	83	4 A.
99	107	85	83	87	79	109	80	82	90	86	Means
93	105	82	87	92	74	82	75	85	87	86	1 AA.
89	101	92	71	102	73	100	77	77	88	83	2 AA.
86	101	80	53	87	76	77	74	76	81	79	3 AA.
79	96	93	81	90	69	125	73	72	87	80	4 AA.
87	101	87	73	93	73	96	75	78	86	82	Means
88	78	89	87	87	76	103	82	(1) 86	87	86 (1)	1 AAS.
85	98	87	75	84	70	115	72	86	85	86	2 AAS.
87	101	84	83	92	71	105	78	89	87	88	3 AAS.
76	96	87	80	90	65	119	68	85	86	85	4 AAS.
84	93	87	82	88	71	111	75	86	86	86	Means
97	104	97	77	99	82	126	83	81	94	87	1 C.
85	102	100	91	93	77	122	78	78	93	86	2 C.
84	108	92	89	90	76	110	78	77	90	84	3 C.
81	107	92	89	87	78	112	78	76	90	83	4 C.
87	105	95	87	92	78	117	79	78	92	85	Means
87	101	81	79	67	77	132	75	(2) 81	86	84 (2)	1 N.
87	93	85	83	75	72	107	75	76	85	81	2 N.
97	109	76	87	67	73	93	78	(3) (95	84	89) (3)	M.
97	108	104	96	91	80	171	77	(4) (91	101	96) (4)	5 O.
79	97	79	80	92	72	101	78	78	83	80	5 A.
96	121	76	89	72	78	98	75	90	89	90	1 } 6
94	109	89	92	72	75	96	90	92	91	91	2 } 6
88	103	87	86	93	85	123	78	86	91	89	7

nd total 19 years.

ast 10 years, and total 19 years.

(3) Averages of 7 years (1855–'61), last 10 years, and total 17 years.

IV.—Record *of* Rainfall *at* Rothamsted (*Parish of* Harpenden) *and* Harpenden Village, *near* St. Alban's, Herts, *in* 1872 *and the* 19 *preceding years.*

Locality	Rothamsted			Rothamsted			Harpenden Village.
Authority	J. B. Lawes			J. B. Lawes			Rev. F. W. Stow.
Size of Gauge	6 ft. × 7 ft. 3 in. = 1/1000 acre			Funnel, 5 inches diameter			Funnel, 5 in. diam.
Height above ground	2 feet			2 feet			8 inches.
Height above sea-level	420 feet			420 feet			350 feet.
Months.	Average 20 Years, 1853-1872.	1872. Total Fall.	1872. More or less than Average.	Average 20 Years, 1853-1872.	1872. Total Fall.	1872. More or less than Average.	1872. Total Fall.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January	2·516	4·680	+2·164	2·172	4·513	+2·341	4·58
February	1·558	1·472	−0·086	1·376	1·325	−0·051	1·53
March	1·755	2·150	+0·395	1·424	1·850	+0·426	2·00
April	1·838	1·626	−0·212	1·616	1·590	−0·026	1·70
May	2·339	2·891	+0·552	2·136	2·883	+0·747	2·92
June	2·414	3·091	+0·677	2·249	3·075	+0·826	3·21
July	2·481	2·892	+0·411	2·295	2·905	+0·610	3·05
August	2·508	2·285	−0·223	2·287	2·280	−0·007	1·78
September	2·403	1·362	−1·041	2·158	1·285	−0·873	1·21
October	3 067	4·673	+1·606	2·740	4·508	+1·768	4·71
November	1·951	3·871	+1·920	1·692	3·753	+2·061	4·09
December	2·015	4·036	+2·021	1·760	3·886	+2·126	4·30
Total	26·845	35·029	+8·184	23·905	33·853	+9·948	35·08

For other Records of Rainfall, supplied by Members of the Council of the Society, see p. VII. of the Statistics published with this number of the Journal.—Ed.

V.—*Report on the Trade in Animals, and its influence on the spread of Foot-and-Mouth and other Contagious or Infectious Diseases which affect the Live Stock of the Farm.* By H. M. Jenkins, F.G.S., Secretary of the Royal Agricultural Society.

Nine years ago two Bills * having reference to the trade in animals were referred to a Select Committee of the House of Commons. The evidence taken was very exhaustive, and represented the opinions then held by the various interests involved in the cattle and meat trades. The witnesses differed in opinion on many points, but they were generally agreed on this one,—that it was *not* advisable to include Foot-and-Mouth in the schedule of Contagious or Infectious Diseases that should come under the operation of the proposed Acts. Considering the state of opinion amongst all sections of agriculturists at the present time, it seems almost incredible that, only nine years ago, it was considered that foot-and-mouth disease was one to which all stock are liable, and that the sooner they have it and get over it, the better for them. There can, however, be no doubt that public opinion was then so strongly against legislative interference with foot-and-mouth disease, that the impetus in that direction—the *vis a tergo*, if it may be so termed—was so powerful that it continued long enough and strong enough to cause foot-and-mouth disease to be excluded from the chief provisions of the Contagious Diseases (Animals) Act, 1869, which, therefore, are applicable only to cattle-plague, pleuro-pneumonia, sheep-pox, and glanders.

This Act is dated August 9th, 1869, and it had scarcely been passed when foot-and-mouth disease acquired the remarkable development which has ever since continued, with fluctuations due to the season. The commencement of the outbreak with which we have to deal is thus described in the Annual Report of the Governors of the Royal Veterinary College for 1869 †:—"During the first part of the year little was heard of this disease, beyond the existence of it in its ordinary form in a few places in England and Scotland. At the beginning of the summer, however, a somewhat sudden augmentation of the disease occurred; and as this circumstance was coincident with the malady assuming an epizootic form on the Continent, it was believed by many persons that its increase here depended on the importation of diseased animals from abroad. An official inquiry, however, did not confirm this opinion. The experience

* The Cattle Diseases Prevention Bill, and The Cattle, &c., Importation Bill.

† 'Journal of the Royal Agricultural Society,' 2nd series, vol. vi. Part II., p. 433.

of the last thirty years has shown that periodical outbreaks of the disease in its epizootic form have occasionally occurred. At no time was the disease more rife than in 1839-40, or nearly three years previously to foreign cattle being allowed to be imported. In that outbreak, cattle, sheep, and pigs, and also the gallinaceous tribe of fowls, suffered equally from the disease as during its recent occurrence."

In the Report of the Governors for 1870 it is stated * that "the year 1870 has witnessed one of the most remarkable outbreaks of the mouth-and-foot disease on record; and, at the time we write, the disease, although much diminished in many parts of Great Britain and Ireland, is far from being exterminated by the sanitary regulations of 'The Contagious Diseases (Animals) Act, 1869.'" †

Unfortunately there are no published statistics which show definitely the magnitude of this outbreak of foot-and-mouth disease; but it is stated in the Report of the Veterinary Department of the Privy Council for 1871, that since the passing of 'The Contagious Diseases (Animals) Act, 1869,' up to the end of 1871, the department had "received information of 92,162 outbreaks of foot-and-mouth disease, in which 1,344,625 animals were attacked. Of these only 1·136 per cent. died, ·327 per cent. were killed, and 98·537 per cent. recovered." The Report does not state whether reliable returns had been received from all counties during the whole of the period indicated; but assuming this to be the case, I shall be able to indicate (though necessarily by means of particular instances, which are therefore not logically conclusive) the cumulative force of the disease by its subsequent further extension, and its greater virulence at least in some districts. Table I., annexed, shows the progress of the disease in Great Britain during 1871. Deducting the 50,577 animals attacked, but not reported as killed, died, or recovered at the end of the year (equal to rather more than the returns of animals affected during the previous fortnight), and adding a fortnight's returns at the rate prevailing at the commencement of the year (that is to say, between 12,000 and 13,000), the percentage of deaths and slaughtered animals to the number attacked is 1·21, or somewhat less than that stated in the Report of the department, already quoted.

More recent returns from Cheshire and the West Riding of Yorkshire (Tables II. and III.) show that although the number of animals attacked decreased at the end of 1871 and beginning

* *Op. cit.*, Second Series, vol. vii. part II., p. 450.

† The same Report contains the following sentence:—"The regulations of 'The Contagious Diseases (Animals) Act' are operating very beneficially in keeping in check the spread of pleuro-pneumonia."

TABLE I.—TABLE showing the Progress of FOOT-AND-MOUTH DISEASE in Great Britain during the Year 1871; compiled in accordance with the Returns received weekly from the Inspectors of the Local Authorities.*

Weeks ending.	Number of Counties reported from.	Number of Farms or other Places upon which Fresh Outbreaks took place.	Total Number of Farms or other Places upon which the Disease existed in each Week.	Number of Animals attacked.							Diseased Animals		
				Cattle.	Sheep.	Goats.	Swine.	Horses.	Other Animals.	Total.	Killed.	Died.	Recovered.
Jan. 7 ..	65	287	1,294	4,301	1,642	..	323	..	..	6,266	9	96	8,111
,, 14 ..	63	287	1,229	3,639	2,266	..	406	..	..	6,311	4	100	6,080
,, 21 ..	61	239	966	3,258	2,222	..	421	..	1	5,905	7	97	6,100
,, 28 ..	59	227	966	2,787	2,987	1	385	..	..	6,160	7	51	6,028
Feb. 4 ..	61	203	894	2,974	2,684	..	351	..	..	6,009	52	50	6,589
,, 11 ..	60	180	799	2,262	1,341	1	277	..	..	3,881	25	81	5,649
,, 18 ..	59	170	763	2,295	2,006	..	428	..	..	4,729	104	43	5,437
,, 25 ..	63	155	623	2,058	597	..	240	..	..	2,895	40	29	4,652
March 4 ..	63	147	617	1,830	1,401	..	140	..	..	3,371	28	11	4,720
,, 11 ..	56	76	447	1,188	268	..	134	..	..	1,590	2	95	3,017
,, 18 ..	54	76	376	1,215	407	..	78	..	..	1,700	11	22	1,951
,, 25 ..	52	74	329	896	173	..	192	..	..	1,261	..	64	1,989
April 1 ..	54	101	310	1,015	295	..	66	..	..	1,376	3	17	1,433
,, 8 ..	47	58	233	742	12	..	15	..	..	769	3	18	1,162
,, 15 ..	44	83	272	784	287	..	40	..	..	1,111	1	12	1,129
,, 22 ..	49	81	267	1,211	37	..	94	..	..	1,342	..	6	1,036
,, 29 ..	50	67	262	943	74	..	102	..	..	1,119	..	8	1,037
May 6 ..	47	79	266	1,014	66	..	22	..	..	1,102	3	8	1,231
,, 13 ..	40	64	225	613	13	..	90	..	..	716	..	20	1,132
,, 20 ..	48	128	302	1,340	17	..	71	..	..	1,428	1	10	907
,, 27 ..	49	110	309	1,231	28	..	20	..	..	1,279	9	8	1,134
June 3 ..	51	116	396	1,515	44	..	34	..	..	1,593	2	20	1,005
,, 10 ..	49	141	403	1,382	3	..	78	..	..	1,463	..	12	934
,, 17 ..	48	125	464	1,635	53	..	18	..	..	1,736	19	12	1,115
,, 24 ..	46	105	384	1,209	64	..	45	..	..	1,318	4	15	1,399
July 1 ..	47	144	437	1,598	611	..	87	..	..	2,296	12	19	1,533
,, 8 ..	41	115	452	1,414	76	..	77	..	..	1,567	..	24	1,267
,, 15 ..	48	221	636	2,168	152	..	87	..	..	2,407	6	35	2,093
,, 22 ..	55	300	857	2,820	120	..	215	..	..	3,155	21	16	1,913
,, 29 ..	51	236	784	2,324	109	..	121	..	..	2,554	6	12	2,497
Aug. 5 ..	59	466	1,182	3,903	667	..	318	..	..	4,888	103	28	2,759
,, 12 ..	64	616	1,401	5,233	281	1	340	..	..	5,855	2	51	2,746
,, 19 ..	70	1,613	2,976	11,686	1,129	32	914	..	..	13,761	126	129	4,302
,, 26 ..	73	2,362	4,669	18,971	1,288	18	1,469	..	..	21,746	40	191	6,379
Sept. 2 ..	75	2,444	6,586	21,738	1,562	..	2,447	1	..	25,748	52	276	12,822
,, 9 ..	76	3,800	9,796	33,160	2,331	2	3,365	..	..	38,858	68	311	23,611
,, 16 ..	77	3,135	9,973	29,117	2,837	1	3,618	..	12	35,585	88	319	26,531
,, 23 ..	79	4,387	11,214	38,665	4,526	2	5,021	..	46	48,263	132	531	39,857
,, 30 ..	82	3,204	12,131	30,901	1,651	1	4,111	3	10	36,680	61	393	36,399
Oct. 7 ..	85	2,742	10,993	27,300	3,925	2	4,271	..	20	35,518	72	512	37,276
,, 14 ..	83	2,369	9,627	27,849	2,871	4	2,999	..	20	33,743	50	329	37,113
,, 21 ..	86	2,506	8,813	26,234	3,785	..	2,847	..	..	32,866	140	250	32,378
,, 28 ..	86	2,418	8,748	25,582	4,325	..	2,232	1	..	32,140	103	201	33,508
Nov. 4 ..	85	2,149	8,088	24,122	5,835	7	2,489	..	..	32,453	24	183	31,777
,, 11 ..	87	1,912	7,327	20,256	4,831	144	1,968	..	..	27,199	66	160	29,088
,, 18 ..	84	1,974	6,822	19,490	5,265	6	1,882	..	..	26,643	54	117	28,359
,, 25 ..	85	2,011	6,966	20,471	7,169	16	2,270	..	..	29,926	23	301	27,100
Dec. 2 ..	84	1,729	6,473	18,435	6,780	..	1,708	..	200	27,123	51	114	26,481
,, 9 ..	83	1,631	6,445	17,748	8,408	1	1,721	..	..	27,878	26	112	25,653
,, 16 ..	81	1,690	6,123	17,873	7,748	8	1,754	..	..	27,383	343	117	30,172
,, 23 ..	84	1,530	5,770	14,985	10,951	1	1,468	..	1	27,409	14	98	28,741
,, 30 ..	78	968	4,732	12,140	8,323	2	1,026	..	..	21,491	37	83	25,749
Total ..	..	52,164	..	519,523	116,546	250	54,931	5	310	691,565	2,051	5,853	633,084

* Extracted from a Report of the Veterinary Department for the year 1871.

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TABLE II.—RETURN of the number of Animals attacked with the FOOT-AND-MOUTH DISEASE, in the County of Chester, from the 23rd August, 1869, to the 4th January, 1873.

Date.	Cattle. Attacked.	Cattle. Killed for Market.	Cattle. Killed for Burial.	Cattle. Died.	Cattle. Recovered.	Cattle. Remaining under Treatment.	Sheep. Attacked.	Sheep. Killed for Market.	Sheep. Killed for Burial.	Sheep. Died.	Sheep. Recovered.	Sheep. Remaining under Treatment.	Pigs. Attacked.	Pigs. Killed for Market.	Pigs. Killed for Burial.	Pigs. Died.	Pigs. Recovered.	Pigs. Remaining under Treatment
* Fortnight ending 4th September, 1869	75	..	..	1	8	66	..	..	..	..	..	..	5	..	..	..	..	5
Month .. 2nd October	705	..	..	3	418	320	44	..	..	..	44	..	21	..	..	..	14	12
.. .. 6th November	706	1	2	3	769	251	..	..	..	..	..	..	3	..	..	1	13	1
.. .. 4th December	530	2	2	2	473	302	..	..	..	..	..	..	15	..	..	..	4	12
.. .. 1st January 1870 ..	458	1	1	3	594	161	..	..	..	..	..	..	38	..	..	..	36	14
.. .. 3rd February	691	..	2	4	555	291	1	..	..	..	1	..	35	..	..	..	24	25
.. .. 5th March	603	..	..	6	652	236	..	..	..	..	..	..	10	..	..	..	28	7
† .. .. 2nd April	†391	..	..	9	450	168	..	..	..	..	..	..	16	..	..	..	23	..
.. .. 7th May	680	3	2	16	451	376	..	..	..	..	..	..	1	..	..	..	..	1
.. .. 4th June	1,215	..	1	21	1,067	502	..	..	..	..	..	..	104	..	..	..	72	33
.. .. 2nd July	2,130	..	3	29	1,607	993	1	..	..	..	1	..	73	..	1	14	59	32
.. .. 6th August	6,150	..	1	42	3,819	3,281	1	..	..	..	..	1	229	..	..	17	149	95
† .. .. 3rd September	†9,559	..	5	81	9,983	2,771	3	..	..	..	1	3	552	5	..	77	467	98
.. .. 1st October	2,714	..	5	24	4,666	790	1	..	..	..	4	..	260	..	..	51	269	38
.. .. 5th November	1,377	..	4	3	1,944	216	..	..	..	..	..	..	79	..	..	14	103	..
.. .. 3rd December	299	..	..	..	412	103	..	..	..	..	..	..	41	..	..	1	6	34
.. .. 7th January 1871 ..	328	..	..	2	364	65	..	..	..	..	..	..	21	..	..	..	55	..
.. .. 4th February	278	1	..	3	238	101	..	..	..	..	..	..	..	..	..	..	..	..
.. .. 4th March	267	..	..	..	280	88	..	..	..	..	..	..	18	..	..	2	16	..
.. .. 1st April	90	..	..	..	150	28	..	..	..	..	..	..	2	..	..	..	..	2
.. .. 6th May	48	..	..	..	51	25	..	..	..	..	..	..	..	..	..	..	2	..
† .. .. 3rd June	†31	..	..	..	31	25	..	..	..	..	..	..	..	..	..	..	..	..
.. .. 1st July	56	..	..	1	77	3	..	..	..	..	..	..	..	..	..	..	..	..
.. .. 5th August	723	1	1	3	147	571	..	..	..	..	..	..	21	..	..	..	10	11
.. .. 2nd September	5,540	3	..	31	2,527	3,550	275	..	..	..	61	214	356	..	..	28	155	184
† .. .. 7th October	†12,458	1	7	75	11,847	4,078	486	3	..	2	680	15	623	..	..	74	516	187
.. .. 4th November	6,496	3	9	60	7,882	2,620	16	5	..	..	23	3	487	..	..	22	573	79
.. .. 2nd December	3,493	3	10	8	4,695	1,397	..	..	..	..	3	..	224	..	..	4	247	52
.. .. 6th January 1872 ..	3,706	8	4	5	4,231	855	17	..	..	..	17	..	132	..	..	..	149	35
.. .. 3rd February	1,146	..	..	3	1,663	335	2	..	..	..	..	2	53	..	..	..	85	3
.. .. 2nd March	632	..	2	2	722	241	..	..	..	..	2	..	30	..	..	..	28	5
.. .. 6th April	467	..	1	4	512	191	..	..	..	..	..	..	22	..	..	..	27	..
† .. .. 4th May	†60	..	..	4	215	32	..	..	..	..	..	..	11	..	..	1	10	..
.. .. 1st June	952	..	..	22	420	542	..	..	..	..	..	..	33	..	..	..	5	28
.. .. 6th July	2,385	3	6	81	2,015	822	312	..	..	6	169	137	91	..	..	19	79	21
.. .. 3rd August	3,132	3	2	31	2,043	1,872	1029	..	..	11	407	748	299	8	..	39	126	147
† .. .. 7th September	†17,252	9	3	149	10,316	8,647	4049	1	..	15	2253	2528	1303	..	..	265	752	433
.. .. 5th October	16,611	2	4	143	19,085	6,027	2606	..	..	13	4431	690	1191	..	2	226	1118	281
.. .. 2nd November	5,768	3	6	72	9,889	1,825	437	..	..	2	887	238	302	..	..	67	455	61
.. .. 7th December	2,131	1	2	16	3,611	326	362	..	..	3	554	43	114	..	..	14	150	11
.. .. 4th January 1873 ..	458	2	1	4	518	259	16	10	..	..	46	3	42	..	..	..	26	27
Total	112,791	53	86	969	111,427	259	9658	19	..	52	9584	3	6860	13	3	936	5881	27

* The machinery for collecting the correct numbers was not complete during this first fortnight.

† The dates and figures marked (†) indicate the maximum and minimum periods of the Disease during each consecutive year; and the Return further proves the undeviating increase and decrease towards the same periods annually; thus pointing to a fact worth the consideration of all Local Authorities, practical Agriculturalists, and Veterinary Science.

The cost of carrying out the Act in the County during the three years and four months has been less than 1000*l*.

THOMAS JOHNES SMITH, *Chief Inspector*.

of 1872, as indicated in the returns for the whole kingdom during the former period (Table I.), yet that during last autumn they reached even a still higher figure than in any previous year since the passing of 'The Contagious Diseases (Animals) Act, 1869.'

TABLE III.—RETURN showing the PROGRESS of FOOT-AND-MOUTH DISEASE in the WEST RIDING of YORKSHIRE for 1872.*

Attacked Week ending	Attacked.	Killed.	Died.	Attacked Week ending	Attacked.	Killed.	Died.
Diseased at commencement of year	743			Brought forward	12,661	23	154
January .. 6	362	2	2	June .. 29	528	..	4
,, .. 13	294	2	2	July .. 6	416	..	6
,, .. 20	267	..	6	,, .. 13	771	1	8
,, .. 27	279	1	4	,, .. 20	644	1	10
February .. 3	245	..	1	,, .. 27	1,041	1	5
,, .. 10	294	..	2	August .. 3	1,718	..	9
,, .. 17	389	1		,, .. 10	3,259	..	31
,, .. 24	213			,, .. 17	3,488	2	37
March .. 2	200			,, .. 24	3,303	2	54
,, .. 9	335			,, .. 31	3,014	..	32
,, .. 16	271	1	7	September 7	4,086	1	65
,, .. 23	206	..	4	,, .. 14	3,091	3	46
,, .. 30	92	1		,, .. 21	2,219	..	25
April .. 6	206	1	2	,, .. 28	2,208	..	42
,, .. 13	430	..	3	October .. 5	1,162	..	30
,, .. 20	539	..	11	,, .. 12	975	1	8
,, .. 27	432	..	6	,, .. 19	1,081	..	5
May .. 4	624	1	14	,, .. 26	881	1	7
,, .. 11	920	..	13	November 2	632	..	6
,, .. 18	895	..	11	,, .. 9	922	..	8
,, .. 25	1,100	..	15	,, .. 16	601	1	5
June .. 1	786	1	7	,, .. 23	622	..	5
,, .. 8	1,070	..	19	,, .. 30	431	..	2
,, .. 15	969	9	12	December 7	494	2	4
,, .. 22	500	3	13	,, .. 14	362	..	1
				,, .. 21	377	9	2
				,, .. 28	404	..	4
Carried forward	12,661	23	154		51,391	48	615

The periods of maximum and minimum increase in Cheshire, to which the Chief Constable draws attention, coincide very nearly with what is shown in Table I. as having occurred, in 1871, all over the kingdom. Foot-and-mouth disease is no doubt imported with live stock, whether from abroad, from Ireland, or from farms at a distance. Animals kept at home and isolated, though they may themselves be affected, do not generally communicate disease; but if they are turned out to grass they infect those with which they come in contact, or which graze after them.

* The last return for the West Riding shows that 451 animals were all diseased on the 8th of February: 406 attacked during the week, and 339 recovered; leaving 518 diseased on February 15, 1873.

This fact accounts for a certain small increase in the returns at the beginning or middle of summer; but the great increase occurs in August, September, and October, when there is the greatest movement of stock all over the country, and when the Irish stores come over to be fattened by the English farmer. Some of the beasts being diseased, they infect others; and the returns increase until, fold-yards and feeding-byres being full, the opportunity of further contagion is removed. From this time the number of fresh attacks begins to decrease, and the favourable change is accelerated by the continued movement of stock from the farm direct to the slaughter-house, until the cycle is completed and the autumn purchases lead to its re-commencement.

This seems to me the most easy and rational explanation of the figures contained in Tables I., II., and III. No doubt, dairying and summer-grazing may require some modification of such explanations in reference to particular localities; but I believe that most of the cattle bought for those purposes come from no long distance, and that therefore, as vehicles of disease, they do not influence the returns to any great extent. This opinion appears to be strengthened by the following comparative statement (Table IV.), which has been kindly furnished by Captain McNeill, the Chief Constable of the West Riding of Yorkshire, and in which the periods of maximum and minimum development of foot-and-mouth disease in Cheshire and the West Riding (the one a dairying and the other a grazing district*) during the last three years are shown to practically coincide, especially as regards the periods of maximum development.

TABLE IV.—RETURN showing the Periods of Maximum and Minimum Development of FOOT-AND-MOUTH DISEASE in CHESHIRE and the WEST RIDING OF YORKSHIRE.

Cheshire.		*West Riding.*	
April 2, 1870	391	July 2, 1870	591
Sept. 3 ,, ...	9,559	Sept. 3 ,, ...	2,117
June 3, 1871	31	July 1, 1871	117
Oct. 7 ,, ...	12,458	Oct. 7 ,, ...	6,275
May 4, 1872	60	April 6, 1872	1,103
Sept. 7 ,, ...	17,252	Sept. 7 ,, ...	17,150

* On this subject Mr. J. Dent Dent, M.P., has favoured me with the following statement with regard to the West Riding of Yorkshire:—

"Of late years the grazing lands of the West Riding have been almost entirely stocked by Irish cattle, generally purchased in the autumn, wintered in the farm-yards, and sold fat from grass; and, until last year, most of the farmers were anxious that their lean stores should get over the foot-and-mouth disease the first autumn before they began to improve. The disease has been more fatal lately, and has, it is said, attacked animals a second time. A certain number of Irish beasts are bought in the spring; for instance, York fortnightly fair on February 13th was so crowded with them, that there was a fall of 1*l.* a head in their price. These purchases go on until June, and the Table for the West Riding shows an increase of disease about that time."

These county returns show a remarkable numerical increase in the actual number of animals attacked in 1872 over those attacked in 1871; but the proportion of deaths and slaughtered animals to those attacked does not vary much from 1¼ per cent. These returns are given on the authority of the chief constables in each case, and therefore possess an official value; and they show undeniably the increased extension of the disease to which I have alluded. Another return, of unofficial origin, is equally interesting as indicating the increased virulence of the disease in a particular district. This statement has been published by Mr. Duckham, editor of the 'Hereford Herd Book,' and is the result of an effort made by the Hereford Chamber of Agriculture to ascertain the amount of the loss sustained by the county in 1872 by foot-and-mouth disease. The Chamber distributed 3500 circulars amongst the stock-owners of the county, and, at the date of Mr. Duckham's publication, replies had been received from two-thirds of them, showing that during last year as many as 27,061 cattle, or 40 per cent. of the total number in the county, had been attacked, and that 1473 of these, or nearly 5½ per cent., had died. The number of sheep and lambs attacked had been 79,399, and of pigs 5576, or a proportion of 26 per cent.; and the deaths in these classes had been 1127 and 1219 respectively. The ascertained number of animals attacked in this county last year was, therefore, 112,036, and the total number of deaths 3819, or a proportion of 3·4 per cent.

It seems unnecessary to pursue further the question of the increased virulence of the disease during the year 1872, as a prolonged discussion might lead to the erroneous inference that the damage done by the foot-and-mouth disease ends with the proved number of deaths that result from its attacks. On the contrary, as the deaths occur chiefly amongst young stock, too weak to resist the effect of the onslaught on the vital powers, they do not in any way represent the loss of condition in feeding stock that ultimately recover, not unfrequently including the loss of a season's keep, or the loss of progeny in the case of breeding animals. The loss from cows casting their calves, and by the death of calves of cows which have been attacked, is one of the most serious features of the disease as affecting our supply of store stock, as it discourages farmers from keeping breeding stock. Indeed, the actual loss to the country in meat cannot be estimated without returns showing the age and sex of the animals attacked, and, in the case of cows, whether they are in calf, and cast their calves, or not.

Those who are not acquainted with the extent of the losses recently brought upon stock-owners by foot-and-mouth disease will probably consider that they have been already overstated; but I feel that the catalogue of evils would be very imperfect if it did not include one that has probably been the most instrumental in producing a change of opinion on the subject. I refer to the increased liability of stock to recurrent attacks. This fact is quite patent to those who go about the country and ascertain the experience of the agricultural community. Veterinary surgeons are doubtless right when they state that this recurrence was well known in 1839 and 1840; but the difference is this, that whereas in those days an animal which had had the disease two or three times might have been considered worthy of a place in the British Museum or the Royal Veterinary College, now such instances are probably well known to the majority of English farmers.

The preceding facts, relating to the recent and prolonged outbreak of foot-and-mouth disease, necessarily engaged the special attention of the Council of the Royal Agricultural Society, and induced them to communicate with the Privy Council, on several occasions. The members of the Society were informed of these steps by paragraphs in the Reports of the Council to the General Meetings held in the December of the last three years; and also by the publication in the 'Journal'* of a correspondence with the Secretary of the Veterinary Department of the Privy Council, including a statement of the principal provisions with respect to foreign animals contained in 'The Contagious Diseases (Animals) Act, 1869,' and Orders issued thereunder.

Continued observation of the circumstances attending the spread of the disease, coupled with a consideration of the above-mentioned regulations relating to foreign animals, induced many agriculturists to modify the opinion referred to by the Governors of the Royal Veterinary College in 1869, with reference to the influence of foreign importations on the recent extension of the epizootic. This change of opinion received an important confirmation in a letter from Mr. J. Dent Dent, M.P., published in the first part of the 'Journal' for last year.† The inference drawn by Mr. Dent from the Records of Contagious Cattle Diseases in Yorkshire during the years 1870-71, was that "the East Riding, which is the most purely agricultural part of the county, has suffered the least, although the port of Hull, to which many German cattle are sent, is situated within it. This fact appears to negative the idea that the spread of these diseases, or their virulence, is proportionate to the introduction of foreign animals. The West Riding has suffered the most; this may be attributable partly to the fact that there was a great amount of foot-and-mouth disease existing in this Riding when the Act was

* Second series, vol. vii. Part II., No. XIV. pp. 457-465, 1871.

† Second series, vol. viii. Part I., No. XV., pp. 179-185.

first put into operation, and still more that the West Riding fairs are the great fairs for Irish cattle" (p. 180).

Additional information, and more particularly numerous complaints respecting the influence of stock bought in Bristol market in disseminating the disease, still further strengthened the opinion that the importation of cattle from Ireland is a much more active means of spreading foot-and-mouth disease than the importations from foreign countries. The Council of the Society therefore deemed it their duty to make a strong representation on the subject to the Vice-President of the Privy Council, and accordingly passed the following resolutions, which were laid before Mr. Forster by a deputation last July:—

1. That the foot-and-mouth disease, in an unusually virulent form, is at the present time extensively prevalent and rapidly increasing.
2. That in the case of both cattle and sheep it causes great loss of condition and a certain percentage of deaths, especially amongst the young stock.
3. That the supplies of meat available for market are in consequence materially diminished and the price proportionately enhanced.
4. That both at the shipping and landing ports in the Irish Channel the precautions requisite to prevent the transit of diseased animals between the two countries are grossly neglected, and in many of the great towns in the interior of the country a great want of vigilance is also observable.
5. That under these circumstances the Royal Agricultural Society feel it their duty to represent strongly to the Government the serious mischief hereby arising, and to urge them to call upon the magistrates and municipal authorities in their respective districts to adopt such restrictive measures as shall seem to them best calculated to abate the evil, and also to insist on the regulations recommended by the Inspectors of the Veterinary Department being promptly and efficiently carried into effect.

(Signed) W. W. Wynn, President.

Subsequently the same resolutions were submitted to Earl Spencer and the Marquis of Hartington (as Lord Lieutenant and Chief Secretary for Ireland).

The substantial result arrived at was that the Vice-President of the Privy Council invited the Council of the Society to state specifically, in writing, what regulations they would recommend. The deputation accepted the invitation on behalf of the Council, but stated that before making their suggestions, they would institute an inquiry into the subject, so as to enable them to base their recommendations on facts collected with that object in view. The Council having entrusted me with this investigation, I devoted about two months of the past autumn to as thorough an inquiry into the cattle-trade generally as time would permit. With this view I attended several markets and fairs (including Ballinasloe) in Ireland, England, and Holland, and at Hamburg; inspected the arrangements for receiving and shipping cattle at the ports of Dublin, Drogheda, Waterford, Cork, Hamburg, Rotterdam, and Harlingen; and those for landing and receiving them at the ports of Liverpool, Holyhead, New Milford, Cardiff, Bristol, London, Harwich, and Hull. Independently of other journeys, I made eleven in cattle-boats, namely, seven traverses of the Irish Sea and four of the German Ocean, and thus had opportunities of observing the actual state of cattle at sea, whether from Ireland or from foreign countries, and also in different states of the weather.

The results of this investigation are contained in the following pages, and they are followed by the suggestions arising therefrom, which the Council of the Society have adopted and communicated to the Vice-President of the Privy Council.

I.—The Legislative Enactments, the Orders in Council, and the Local Authorities.

Great Britain.—It is not my purpose to describe in detail how the provisions of the Contagious Diseases (Animals) Act, 1869, are carried out in every county of Great Britain, or even of England. Such a description with reference to foot-and-mouth disease—the special subject of this report—would be both tedious and useless, as it is not included in the Act, except generically amongst those "miscellaneous" diseases which are known to be either contagious or infectious (sect. 57).* The Privy Council,

* This section is, *in extenso*, as follows :—

"57. If any person exposes in a market or fair or other public place where horses or animals are commonly exposed for sale, or exposes for sale in any sale-yard, whether public or private, or places in a lair or other place adjacent to or connected with a market or fair, or where horses or animals are commonly placed before exposure for sale, or sends or causes to be carried on a railway, or on a canal, river, or other inland navigation, or on a coasting vessel, or carries, leads, or drives, or causes to be carried, led, or driven on a highway or thoroughfare, any horse or animal affected with a contagious or infectious disease, he shall be deemed guilty of an offence against this Act, unless he shows to the satisfaction of the justices before whom he is charged that he did not know of the same being so affected, and that he could not with reasonable diligence have obtained such knowledge.

"Where any horse or animal so affected is exposed or otherwise dealt with in contravention of this section, an inspector of the local authority, or any officer of the local authority authorised to act in execution of this Act, may seize the same, and cause it, if affected with glanders, cattle-plague, or sheep-pox, to be slaughtered, and if affected with any other contagious or infectious disease, to be removed to some convenient and isolated place, and to be there kept for such time as the local authority think expedient; and the local authority may recover the expenses of the execution by them of this section from the owner of the horse or animal, or from the consignor or consignee thereof, who may recover the same from the owner.

"In case of a conviction for an offence under this section no compensation shall be payable in respect of any animal slaughtered under this section.

"Notwithstanding anything in this section, the Privy Council may from time to time, by order, make such further or other provision as they think expedient respecting animals becoming affected with foot-and-mouth disease or any other contagious or infectious disease not being cattle-plague, pleuro-pneumonia, sheep-pox, or glanders, while exposed or placed or being carried, led, or driven as aforesaid, and any such order shall be deemed part of this section."

however, are authorised to make "from time to time, by order, such further or other provision as they think expedient respecting animals becoming affected with foot-and-mouth disease," &c. This power has been used to enact as follows (Animals Order, dated December 20, 1871, came into operation beginning of the year 1872):—

"§ 28. A local authority may, from time to time, with the view of preventing the spreading of foot-and-mouth disease, make regulations for the following purposes, or any of them:—

"For prohibiting or regulating the movement out of any field, stable, cowshed, or other premises in which foot-and-mouth disease has been found to exist, of any animal that has been in the same field, stable, cowshed, or other premises with or in contact with any animal affected with foot-and-mouth disease."

The responsibility of taking measures to prevent the spread of foot-and-mouth disease therefore rests with the local authorities; that is to say, they *may* take such measures if they choose to do so; but if they do not consider it expedient, or worth the trouble and expense of doing so, the Privy Council has no power to compel them.

There are two classes of local authorities, who may be termed, respectively, the "urban" and the "rural" authorities; and most of the variations of practice which may be discovered amongst local authorities in England appear capable of arrangement into two classes, which vary according to the urban or rural interests of the districts. Thus, in ports and other large towns and cities, the local authorities appoint a duly qualified veterinary inspector to carry out, not only § 57 of the Act, but more particularly sections having reference to more serious diseases, such as sheep-pox, which, if passed undetected in their market, would probably result in a sacrifice of human life, and would certainly cause a great public scandal. Such local authorities seldom make regulations under § 28 of the Animals Order, and it would be against their interest to do so. Their desire is to make their market as free and attractive as possible; and although persons sending diseased animals are prosecuted and fined, yet it is not to be expected that the authorities of towns would make regulations with a view of *restricting* the movement of such diseased animals and of other stock that had been in contact with them, unless they were compelled by law to do so. On the contrary, they are only too anxious to get rid of diseased animals as soon as possible. In Ireland, as we shall see, such regulations exist on paper, but are not carried out by the authorities; and some magistrates in Great Britain appear to hold the opinion that it is useless to impose fines for offences against the Contagious Diseases (Animals) Act, because the Act does not provide any machinery for enforcing them. In Great Britain, however, as a general rule, I believe it may be truly stated that what the authorities undertake to do they pursue with every desire and intention of fulfilling their engagements. What the agricultural public has to complain of, in the case of urban authorities, is simply (1) that they take no cognizance of diseased animals until they come before them on the market; and (2) that they frequently get rid of such diseased animals as quickly as possible, without having regard to the number of other animals that may have been infected by them on the market, or which they may afterwards infect on the road to their new destination, or at such destination when they arrive there. How far this is the fault of the local authorities, and how far it is inherent in the Contagious Diseases (Animals) Act, 1869, will appear in the following pages.

The local authorities of rural districts do not often incur the expense of appointing qualified veterinary surgeons as inspectors; but they frequently make regulations under § 28 of the Animals Order, 1871, of which the following may be taken as an example:—

1. That no animal which shall have been in the same field, stable, cowshed, or other premises, or in contact with any animal affected with the foot-and-mouth disease, shall be removed out of any field, stable, cowshed, or other premises in which that disease has been found to exist, without a licence signed by the inspector appointed to issue licences under the said Act.

2. That the licence so to be given shall specify the date and the hours within which such removal shall take place, and the place to which any such animal shall be removed; and no animal shall be removed otherwise than as specified in such licence.

3. That the occupier of any stable, shed, building or place used by any animal affected with the foot-and-mouth disease shall, upon notice for that purpose given by any inspector, and in such manner as may be specified in such notice, cleanse and disinfect every such stable, shed, building, or other place.

4. That any person offending against or neglecting to comply with any of the above regulations, shall be liable to a penalty not exceeding 20*l.* for every such offence.

By Order.

N.B.—By Order in Council of 10th August, 1869, every person having in his possession or under his charge any animal (including a horse) affected with a contagious or infectious disease, shall observe the following rules:—

1. He shall, as far as practicable, keep such animal separate from animals not so affected.

2. He shall, with all practicable speed, give notice to a police constable of the fact of the animal being so affected.

In default he is liable to a penalty not exceeding 20*l.*

These and other regulations of the local authority, and the provisions contained in the Act itself, are generally carried out under the supervision of the county police. It must be conceded that the police perform these somewhat extraneous duties in a manner that is, on the whole, highly creditable to their intelligence and organisation; and if a sufficient number of veterinary surgeons were attached to the constabulary as consulting inspectors,* if uniformity of action amongst the local authorities of rural districts were insisted upon by the central Government, and if certain alterations in the law (to be presently indicated) were also obtained, the effect upon the spread of foot-and-mouth disease would, doubtless, be very soon manifest to the agricultural public.

The omission of foot-and-mouth disease from the provisions of the Contagious Diseases (Animals) Act relating to the discovery and prevention of disease appears to be one principal reason why that epizootic causes more loss of meat to the nation than all the rest put together. The preliminary sections under this part of the Act (Part IV.) are as follows:—

"§ 31. An Inspector of a Local Authority, on receiving information of the supposed existence of cattle-plague, pleuro-pneumonia, or sheep-pox, or having reasonable ground to suspect that any of those diseases exists in any place within his district, shall proceed to that place with all practicable speed, and execute and discharge the powers and duties by or under this Act conferred and imposed on him as Inspector.

"§ 32. An Inspector or other officer of a Local Authority authorised to act in the execution of this Act may at any time enter any field, stable, cow-shed, or other premises within his district, where he has reasonable grounds for supposing that any animal affected with cattle-plague, pleuro-pneumonia, or sheep-pox is to be found, for the purpose of executing this Act, but shall, if required, state in writing the grounds on which he has so entered.

"If any person refuses admission to such Inspector or officer acting under this Section, he shall be deemed guilty of an offence against this Act.

"§ 33. The certificate of an Inspector of a Local Authority, to the effect that an animal within his district is affected with cattle-plague, pleuro-pneumonia, or sheep-pox, shall, for the purposes of this Act, be conclusive evidence in all Courts of Justice and elsewhere of the matter certified."

The foregoing sections thus give to the inspector right of entry into premises, and liberty to inspect animals, in cases, or suspected cases, of cattle-plague, pleuro-pneumonia, and sheep-pox; and in these diseases the inspector's certificate is conclusive evidence of the matter certified. But with regard to foot-and-mouth disease there are no such provisions; on the contrary, the omission of the name of that disease from the foregoing section, probably amounts, by implication, to an enactment that the inspector has no such rights in reference to it as he has with regard to the diseases that are the special subjects of those sections.

* Unfortunately the tendency at present is, in some districts, to disallow the expenses of the Veterinary Inspector of the Local Authority, incurred in attending fairs and markets. All provisions should be compulsory, otherwise they are useless.

The inspector being hampered in these respects, and no special regulations having been made with regard to the inspection of British or Irish animals landed there,* he does not take upon himself the thankless and somewhat invidious task of laying information against consignees of diseased animals unless they send them on the market. It is, indeed, difficult to see how, under the present Act, the consignees of cattle imported from Ireland could be prosecuted, if the cattle on landing were affected with a contagious or infectious disease. The Act was passed "to prevent the introduction into Great Britain of contagious or infectious diseases among cattle, sheep, and other animals, by prohibiting or regulating the importation of *foreign animals*," and, further, "to provide against the spreading of such diseases in Great Britain." As it does not extend to Ireland, it may also be considered doubtful whether the term "coasting vessel" in § 57 includes a steamboat engaged in the cross-channel trade between England and Ireland. Whether or no, the consignee could easily prove "that he did not know of the same [the diseased animal] being so affected, and that he could not with reasonable diligence have obtained such knowledge" (§ 57). Another consideration should not be lost sight of: the inspector of the local authority at the port is generally a veterinary surgeon in practice in the district, and his income often consists chiefly of the fees which he legitimately receives as a practitioner from the salesmen on whose stock he has, as inspector, most frequently to pronounce a judgment. When, therefore, it is urged that inspection at the port is impossible; or that, if it were possible, it would be useless, because the inspectors would be bribed, it is assumed that the existing system must necessarily continue.

But there appears no reason why so important an office as inspector at a port should not occupy the whole of the time of a duly qualified veterinary surgeon, who should receive a salary commensurate with the amount of knowledge required to perform the duties of his office and with the magnitude of the interests entrusted to his supervision. It may be that the appointment of such an inspector at some of the smaller ports would not be warranted by the number of animals that would pass through his hands. In such a case it would surely be a smaller evil to strike that port out of the list of those at which animals may be imported, than to leave open a single doorway for the entrance of disease. At the present time, however, it is not a question of doorways, because Irish animals are landed in England without inspection, and are driven off by their owners

* Foreign animals are dealt with according to the Act by the Government inspector.

without let or hindrance. If they were stopped by an inspector, or by a policeman, or by a private individual, on the ground that they were affected with foot-and-mouth disease, and if the owner were summoned for committing an offence against the Act, such as driving diseased cattle along the high road, the evidence of the inspector would not, under the Act, be more conclusive as to the fact of the animals being affected with foot-and-mouth disease than the evidence of a policeman, or that of a private individual (§ 33). On the other hand, the owner might bring an overwhelming number of men "who had been with cattle all their lives," &c., to swear that the beasts had no foot-and-mouth disease at all, but were only footsore and thirsty; that the sheep were suffering from foot-rot, "all along of the wet, your honour." Such defences sometimes are, I am told, set up, even when dealers are prosecuted for exposing diseased animals for sale in a public place; and they show how necessary it is that the inspector's certificate should be received as conclusive evidence of the existence of disease. I have an instance noted, on most reliable authority, of a lot of pigs having been seized while affected with foot-and-mouth disease; but the owner, on being brought before the magistrate, was acquitted of the charge of committing an offence against the Act, and was allowed to drive his diseased pigs home again, because there was no evidence before the magistrate except the word of the police on one side and that of the owner on the other. If an inspector is incompetent he should be removed; but while he remains inspector his decision should be as final in the less fatal cases of sheep-scab and foot-and-mouth as in the more fatal diseases of sheep-pox and pleuro-pneumonia.

Sections 31 and 32 refer to the right of entry into fields, stables, and other premises, which an inspector possesses in the event of his suspecting, or receiving information as to, the existence of cattle-plague, sheep-pox, and pleuro-pneumonia. The necessity of this right of entry being extended to foot-and-mouth, and, indeed, generally to all contagious or infectious diseases of stock, will be understood by the description of the arrangements and practices at some of the English and Irish ports, and especially at the port of Bristol.

Ireland.—The legislative enactments which in Ireland take the place of the Contagious Diseases (Animals) Act, 1869, are known as "The Cattle Disease Act (Ireland), 1866," and "The Cattle Disease (Ireland) Amendment Act, 1870." These two Acts are construed together; and their provisions, with those of the Orders of the Irish Privy Council founded on them, are carried out by a Veterinary Department, as in England. The constitution of the Irish Veterinary Department is, however, essentially different from that of the English. In Ireland there are no "local authorities," and the administration of the Cattle Diseases Acts is carried out entirely by the Royal Irish Constabulary, under the direction of Professor Ferguson, the chief of the Veterinary Department in Dublin. Whatever objections may be urged against this particular development of the principle of centralisation, it has one undoubted merit, that it secures uniformity of action throughout the country. On the other hand it tends to diminish, as will be seen, the sense of local magisterial responsibility, one result being that offenders against the law are not always adequately punished on conviction.

The administrative work of the department being entirely in the hands of a disciplined force, and all reports being forwarded to one central authority on a uniform plan, are conditions which must enable the Irish Veterinary Department to keep a more watchful eye on the development or the subsidence of an epizootic, than is possible under the English system.

According to the detailed returns in the possession of the Veterinary Department,* it appears (see Table V.) that in January, 1871, there were only six farms or other places in Ireland which were reported as affected with foot-and-mouth disease; in February there were only four, and in March five. During April and May not a single infected place was reported, and Ireland was therefore regarded as entirely free from the disease. However, on June 1st the reappearance of foot-and-mouth was reported from Castle Pollard, in county Westmeath, and was said to have been brought by calves imported from England. Whether this was the case or not, by the end of June, 12 infected places had been reported; during July the number increased to 338, and in August to 2414, so rapidly did the disease spread; in September the number rose to 3038, and in October it attained the maximum number of 4058 infected places. In November there were 3415, and in December 2679 infected places. During the whole year no fewer than 220,570 cattle, 21,178 sheep, and 23,036 pigs (see Table VI.) were reported as affected with the disease; but, as already stated, nearly the whole of these must have received the germs of contagion during the last six months of the year.

The distribution of the disease presents some points of interest. Table VI. shows that considerably more than one-half the affected animals were reported from the province of Leinster; and if to that total we add the reported cases from the counties of Tipperary and Waterford, we get about three-fourths of the total number.

* The publication of these Returns in the Society's 'Journal' has been kindly sanctioned by His Excellency the Lord Lieutenant of Ireland.

TABLE V.—Return Showing the Number of Farms, Lands, Premises, and Places under restrictions in each County in Ireland on the last day of each Month in the Year 1871, in consequence of being infected with Foot-and-Mouth Distemper and Pleuro-Pneumonia.

	Provinces and Counties.		January 31st.			February 28th.			March 31st.			April 30th.			May 31st.			June 30th.			July 31st.			August 31st.			September 30th.			October 31st.			November 30th.			December 31st.		
			Foot-and-Mouth.	Pleuro-Pneumonia.	Foot-and-Mouth and Pleuro-Pneumonia.	Foot-and-Mouth.	Pleuro-Pneumonia.	Foot-and-Mouth and Pleuro-Pneumonia.	Foot-and-Mouth.	Pleuro-Pneumonia.	Foot-and-Mouth and Pleuro-Pneumonia.	Foot-and-Mouth.	Pleuro-Pneumonia.	Foot-and-Mouth and Pleuro-Pneumonia.	Foot-and-Mouth.	Pleuro-Pneumonia.	Foot-and-Mouth and Pleuro-Pneumonia.	Foot-and-Mouth.	Pleuro-Pneumonia.	Foot-and-Mouth and Pleuro-Pneumonia.	Foot-and-Mouth.	Pleuro-Pneumonia.	Foot-and-Mouth and Pleuro-Pneumonia.	Foot-and-Mouth.	Pleuro-Pneumonia.	Foot-and-Mouth and Pleuro-Pneumonia.	Foot-and-Mouth.	Pleuro-Pneumonia.	Foot-and-Mouth and Pleuro-Pneumonia.	Foot-and-Mouth.	Pleuro-Pneumonia.	Foot-and-Mouth and Pleuro-Pneumonia.	Foot-and-Mouth.	Pleuro-Pneumonia.	Foot-and-Mouth and Pleuro-Pneumonia.	Foot-and-Mouth.	Pleuro-Pneumonia.	Foot-and-Mouth and Pleuro-Pneumonia.
1	Ulster.	Antrim	..	..	..	..	..	..	..	..	..	..	1	..	..	2	..	..	3	..	..	4	..	9	4	..	28	1	..	44	6	..	23	6	..	29	..	..
2		Armagh	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	12	..	..	47	..	..	60	..	..	36	..	..	13	..	..
3		Cavan	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	29	..	..	66	..	..	97	..	..	89	..	..	52	..	..
4		Donegal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	..	..	47	..	..	31	2	..	35	1	..
5		Down	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	2	..	16	4	..	63	5	..	61	2	..	28	..	..	16	1	..
6		Fermanagh	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	8	..	..	38	..	..	21	..	..	12	..	..
7		Londonderry	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	21	..	..	43	..	..	10	..	..	5	..	..
8		Monaghan	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	26	1	..	48	..	..	61	..	..	20	..	..	20	..	..
9		Tyrone	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	8	..	..	27	..	..	75	..	..	37	..	..	22	..	..
		Total	..	..	..	..	..	..	..	..	..	..	1	..	..	2	..	..	3	..	2	7	..	101	9	..	313	6	..	529	8	..	298	8	..	214	2	..
1	Leinster.	Carlow	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	22	..	..	108	1	..	91	..	..	86	..	..	70	..	..
2		Dublin	1	3	..	..	5	..	..	4	..	..	..	..	..	..	..	..	..	..	52	13	..	293	5	..	179	4	2	59	2	1	31	4	1	13	1	..
3		Kildare	..	1	..	1	1	..	1	..	..	..	..	..	..	..	..	..	..	..	9	3	..	85	..	..	286	2	..	139	4	..	65	..	..	59	..	..
4		Kilkenny	..	35	..	..	43	..	..	34	..	..	24	..	..	26	..	..	21	..	..	21	..	8	22	..	167	9	..	309	10	..	313	27	6	333	17	2
5		King's County	..	..	..	..	..	..	..	1	..	..	1	..	..	1	..	..	1	..	7	1	..	38	2	..	60	..	..	120	..	..	145	..	..	173	..	..
6		Longford	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	96	..	..	158	..	..	131	..	..	77	..	..	37	..	..
7		Louth	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	24	..	..	246	..	..	118	..	..	41	..	..	25	..	..	9	..	..
8		Meath	2	..	..	..	1	..	..	1	..	..	..	..	..	..	..	..	2	..	149	..	..	779	8	2	116	..	..	58	..	..	15	1	..	11	..	..
9		Queen's County	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	..	..	..	..	34	1	..	200	..	..	239	..	..	176	..	..
10		Westmeath	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	8	2	..	54	6	..	430	8	..	293	1	..	153	..	..	105	..	..	57	..	..
11		Wexford	..	4	..	..	2	..	..	1	..	..	..	..	..	..	..	..	1	..	..	1	..	6	..	..	26	..	..	75	3	..	103	1	..	82	..	..
12		Wicklow	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	30	..	..	139	..	..	230	..	..	113	..	..	33	..	..	26	1	..
13		Dublin Metropolitan Police District	..	47	..	1	48	1	4	21	1	..	10	..	..	11	..	4	21	..	11	9	..	49	3	1	41	3	..	10	3	..	8	3	..	3	6	..
		Total	5	91	..	3	101	1	5	63	1	..	35	..	..	38	..	12	49	..	336	55	..	2191	48	3	1816	21	2	1199	22	1	1275	36	7	1049	25	2
1	Munster.	Clare	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	21	..	..	76	..	..	152	..	..
2		Cork	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	..	..	71	..	..	123	..	..	216	1	..
3		Kerry	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	12	..	..	10	..	..	53	..	..
4		Limerick	..	..	..	..	..	..	..	..	..	..	1	..	..	2	..	..	2	..	..	5	..	..	4	..	5	..	..	50	1	..	103	1	..	186	3	1
5		Tipperary	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	68	..	..	282	3	..	367	3	..	311	..	..
6		Waterford	..	1	..	..	1	..	..	1	..	..	..	..	..	1	..	..	1	..	..	2	..	49	5	..	538	1	..	538	2	..	236	..	..	111	2	..
		Total	..	4	..	..	1	..	..	1	..	..	1	..	..	3	..	..	3	..	..	7	..	49	9	..	616	1	..	974	6	..	915	4	..	1059	6	1
1	Connaught.	Galway	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	13	1	..	161	..	..	311	..	..	127	..	..
2		Leitrim	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	17	..	..	46	..	..	99	..	..	118	..	..	51	..	..
3		Mayo	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	43	..	..	135	..	..	114	..	..	33	..	..
4		Roscommon	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	..	56	1	..	165	..	..	307	2	..	171	..	..	86	..	..
5		Sligo	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	26	..	..	351	..	..	213	..	..	60	..	..
		Total	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	..	73	1	..	293	1	..	1056	2	..	927	..	..	357	..	..
		General Total	6	95	..	4	102	1	5	64	1	..	37	..	..	43	..	12	56	..	338	70	..	2414	67	3	3038	29	2	4058	38	1	3415	48	7	2679	33	3
			101			107			70			37			43			68			408			2484			3069			4097			3470			2715		

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TABLE VI.—General Abstract, Showing the extent to which the Foot-and-Mouth Distemper prevailed in each County in Ireland during the Year ended 31st December, 1871.

No.	Provinces and Counties.	Number of Police Districts in each County.	Number of Police Districts in which Infected Farms were situated.	Number of Farms in each County.	Number of Infected Farms, &c., in each County.	Percentage of Infected Farms as compared with the Total Number of Farms.	Number of Cattle, Sheep, and Swine, in each County.			Number of Cattle, Sheep, and Swine, on Infected Farms, &c., in each County.			Number of Cattle, Sheep, and Swine, which became affected in each County.			Number of Cattle, Sheep, and Swine, which Died from the Disease.			Slaughtered on account of the Disease.			Percentage of Cattle, &c., affected as compared with the Total Number of Cattle, &c., in each County.			Percentage of Cattle, &c., affected, as compared with the Number of Cattle, &c., on Infected Farms.			Percentage of Cattle, &c., which Died as compared with the Number affected.			Percentage of Cattle, &c., Slaughtered as compared with the Number affected.		
							Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.
	ULSTER.																																
1	Antrim	62	27	25,636	195	0·76	158,659	87,596	70,607	2,052	833	626	988	134	21	2	1	1	1	..	5	·62	·15	·03	48·1	16·08	3·4	·2	·75	4·7	·1	..	23·8
2	Armagh	36	31	23,685	302	1·27	78,595	12,101	31,967	2,180	317	731	1,007	4	18	3	..	.	..	..	..	1·28	·03	·05	46·1	1·1	2·4	·3	..	..	..	..	..
3	Cavan	37	36	21,647	483	2·23	121,464	26,526	49,211	5,140	1,705	1,535	1,971	3	302	5	..	37	..	..	..	1·62	·01	·61	62·5	·17	19·7	·3	..	12·2	..	..	..
4	Donegal	71	15	33,165	129	·38	182,018	213,365	43,086	2,203	267	360	983	2	27	5	..	..	..	1	..	·54	·001	·06	44·6	·75	7·5	·5	..	..	..	50·	..
5	Down	44	31	32,010	353	1·102	136,446	60,020	62,378	3,161	976	1,057	1,447	67	100	11	2	5	..	1	2	1·06	·11	·16	45·7	6·9	9·4	·75	2·9	5	..	1·5	2·
6	Fermanagh	28	20	14,517	148	1·01	109,874	17,653	30,368	1,847	415	366	789	12	37	3	..	9	..	..	..	·71	·06	·12	42·7	2·9	10·1	·38	..	24·4	..	..	..
7	Londonderry	21	13	19,516	140	·71	114,301	46,174	43,744	1,763	122	215	667	..	37	1	..	2	..	..	6	·58	..	·08	37·9	..	17·2	·15	..	5·4	..	..	16·2
8	Monaghan	21	23	20,349	325	1·605	79,038	15,902	32,114	3,271	1,249	887	1,474	106	221	11	..	35	..	..	..	1·86	·67	·69	45·06	8·1	25·	·9	..	15·8	..	..	..
9	Tyrone	35	27	31,421	213	·77	178,969	61,851	56,670	2,838	1,240	715	1,248	5	84	3	..	..	..	..	..	·68	·008	·14	43·9	·4	11·7	·21	..	..	..	..	..
	Total	361	228	221,946	2,322	1·04	1,159,366	541,448	420,145	22,455	7,204	6,493	10,574	333	847	47	3	89	1	2	13	·91	·06	·201	47·09	4·6	13·04	·44	·9	10·5	·009	·6	1·5
	LEINSTER.																																
1	Carlow	19	19	5,664	466	8·22	44,539	62,266	29,511	10,511	9,287	3,598	5,857	224	798	11	..	45	1	1	..	13·15	·36	2·6	55·7	2·4	22·2	·19	..	5·6	·02	·45	..
2	Dublin	39	39	8,792	717	9·72 }	16,760	58,419	26,315	14,096	8,823	1,407	7,775	608	198	46	..	27	10	..	..	17·68 }	1·04 }	·83 }	55·1	6·9	14·1	·6	..	13·6	·12	..	..
3	Dublin Metropolitan District	16	16	B.	139		A.	..	..	1,216	120	256	483	..	23	28	..	..	1	..	..				38·7	.	9·	5·8	..	..	·02	..	..
4	Kildare	39	36	10,056	1,118	14·101	81,469	138,710	18,686	25,828	21,750	3,257	11,387	949	543	26	..	12	4	2	2	13·98	·6	2·8	44·1	3·8	16·6	·23	..	2·2	·01	·22	·37
5	Kilkenny	51	53	15,482	1,596	10·31	110,331	109,599	61,827	28,176	11,953	11,520	13,196	140	2,683	33	..	199	3	..	17	11·96	·13	4·3	46·8	1·1	23·3	·25	..	7·4	·02	..	·63
6	King's County	50	47	11,915	725	6·07	63,011	133,652	26,116	12,913	19,221	2,577	7,626	2,624	744	18	3	34	1	9	2	12·1	1·9	2·8	59·06	13·6	28·8	·24	·11	4·5	·01	·34	·27
7	Longford	28	28	9,162	713	8·109	56,961	33,656	21,411	12,619	5,888	2,184	5,593	627	638	19	1	2	..	..	..	9·81	1·9	2·9	43·5	10·6	29·2	·34	·17	·31	..	..	..
8	Louth	29	27	8,494	516	6·07	34,100	47,638	18,768	8,218	7,522	1,228	4,797	672	278	20	2	36	..	..	..	13·94	1·4	1·4	58·3	8·9	22·6	·41	·29	12·9	..	..	..
9	Meath	51	50	13,151	1,608	12·22	159,562	200,403	22,440	58,261	37,454	2,931	32,050	3,492	818	103	..	5	16	..	..	20·08	1·7	3·6	55·	9·3	27·9	·32	..	·61	·05	..	..
10	Queen's County	33	33	12,201	942	7·66	72,189	95,517	31,316	15,512	12,294	3,861	8,379	657	880	13	1	31	1	..	8	11·7	·69	2·5	51·1	5·3	25·3	·15	·15	5·5	·01	..	·9
11	Westmeath	51	50	11,719	1,676	11·301	92,509	148,791	23,225	38,321	42,351	4,889	21,338	6,710	1,540	72	6	37	6	5	1	23·04	4·5	6·6	55·7	13·5	31·5	·31	·09	2·4	·03	·08	·06
12	Wexford	41	37	16,932	345	2·05	110,708	138,140	81,472	5,913	4,261	2,939	2,933	42	915	13	..	23	..	3	1	2·65	·03	1·1	49·6	·98	31·1	·44	..	2·5	..	7·14	·109
13	Wicklow	35	30	8,983	618	6·88	75,135	130,616	30,390	12,770	8,971	2,882	6,658	724	1,104	23	3	47	..	3	..	10·18	·3	3·6	52·1	8·09	38·3	·3	·41	4·2	..	·41	..
	Total	491	461	132,671	11,511	8·68	917,617	1,366,507	394,600	211,395	192,875	43,532	129,072	17,443	11,162	425	16	488	43	23	31	13·62	1·2	2·7	52·8	9·04	25·6	·33	·09	4·3	·03	·13	·28
	MUNSTER.																																
1	Clare	54	15	48,069	915	1·908	169,229	167,347	52,579	8,132	4,196	1,176	2,452	12	146	5	..	2	..	..	5	1·45	·007	·28	30·2	·26	12·4	·2	..	1·31	..	..	3·5
2	Cork	147	91	36,593	461	1·27	316,550	313,323	197,298	12,253	6,023	5,856	6,151	104	1,276	19	..	45	1	..	18	1·77	·03	·65	50·2	1·7	21·7	·3	..	3·5	·02	..	1·4
3	Kerry	40	11	19,151	93	·47	222,606	129,510	73,442	1,610	226	367	715	..	85	2	..	..	..	..	12	·32	..	·11	44·5	..	23·1	·26	..	..	..	..	14·1
4	Limerick	78	57	17,807	737	4·13	187,781	69,213	77,583	15,060	5,811	3,315	6,368	195	371	30	..	2	..	..	..	3·4	·27	·47	42·2	3·3	11·2	·47	..	·56	..	..	..
5	Tipperary	136	118	25,483	1,428	5·61	218,152	255,180	101,704	31,031	20,567	9,580	14,985	808	2,000	30	..	123	..	..	13	6·87	·32	1·9	48·3	4·02	20·8	·2	..	6·15	..	..	·65
6	Waterford	41	10	9,518	1,781	18·68	86,448	54,542	65,580	37,214	8,365	21,102	20,668	296	5,772	67	..	399	4	..	4	23·9	·54	8·8	55·4	3·5	27·3	·32	..	6·9	·02	..	·07
	Total	436	381	126,151	5,051	4·003	1,230,766	1,019,145	569,177	105,330	45,518	41,396	51,341	1,415	9,650	153	..	571	5	..	52	4·17	·13	1·7	48·7	3·1	23·3	·3	..	5·8	·009	..	·53
	CONNAUGHT.																																
1	Galway	91	68	38,592	1,013	2·62	156,211	681,673	72,274	19,474	45,066	1,621	8,230	695	274	8	..	..	1	..	4	5·27	·12	·38	42·3	1·5	16·8	·1	..	..	·01	..	1·5
2	Leitrim	30	83	14,930	511	3·42	103,106	20,285	30,883	5,528	755	1,022	2,256	..	136	11	..	17	..	..	3	2·18	..	·44	40·8	..	13·3	·48	..	12·5	..	..	2·2
3	Mayo	58	49	36,971	627	1·69	172,016	340,612	65,622	9,619	18,257	773	3,408	51	97	12	..	1	2	..	..	1·98	·01	·14	35·4	·27	12·5	·35	..	1·03	·05	..	..
4	Roscommon	51	52	24,273	1,150	6·84	108,860	195,535	36,536	21,442	27,429	2,798	9,685	802	625	26	..	9	..	..	2	9·34	·41	1·7	45·1	2·9	22·3	·27	..	1·4	..	..	·32
5	Sligo	31	33	16,327	977	5·98	99,857	63,476	27,237	11,512	4,324	1,465	6,004	441	245	18	1	17	..	10	..	6·01	·69	·89	52·01	10·2	16·7	·29	·23	7·	..	2·26	..
	Total	270	285	128,036	4,584	3·58	635,353	1,301,581	232,832	67,605	95,831	7,682	29,583	1,989	1,377	75	1	44	3	10	9	4·65	·15	·59	43·8	2·07	17·9	·25	·05	3·1	·01	·5	·65
	General Total	1627	1291	608,861	23,468	3·85	3,973,102	4,228,721	1,616,751	439,785	341,428	99,103	220,570	21,178	23,036	700	20	1192	52	35	107	5·55	·5	1·4	50·1	6·2	23·2	·32	·09	5·1	·02	·11	·46

A.—Not known, as the Cattle, Sheep, and Swine within the Dublin Metropolitan Police District are not given separately in the Agricultural Statistics for the year 1871, but are included in the total number of Cattle, Sheep, and Swine in the County of Dublin. Consequently no percentage can be made as to the number of Cattle, &c., which became affected out of the total number of Cattle, &c., in the district.

B.—Explanation same as at A. The number of Farms, &c., not given separately.

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The disease prevailed most extensively in that portion of the east of Ireland adjacent to the three great ports of shipment in that region—Dublin, Drogheda, and Waterford—and in those counties which are the chief seats of the cattle traffic. Thus the proportion of cattle affected in county Westmeath was 23·04 per cent. of the total registered number; in Meath it was 20·08, in Louth 13·94, and in county Dublin 17·68—all these counties being in the immediate neighbourhood of Dublin and Drogheda. In the county Waterford the proportion was as high as 23·9 per cent., and in the adjacent county of Tipperary the comparatively low percentage of 6·87 represented very nearly 15,000 beasts. The counties which connected these two groups also suffered very considerably, Carlow showing a proportion of 13·15, Kildare of 13·98, Kilkenny of 11·96, King's County of 12·1, and Queen's County of 11·7 per cent.; while Wexford, which was out of the way of the traffic, was affected to the extent of only 2·65 per cent. The influence of a great fair may be traced by the returns for the county Galway, shown in Table V. Ballinasloe fair, the largest for sheep and cattle in Ireland, is held just within the confines of this county, in the first whole week in October. The county was reported to be free from both foot-and-mouth and pleuro-pneumonia from March to August, 1871 (both months inclusive). In September the "distemper," as foot-and-mouth disease is termed in Ireland, was reported on 13 farms, and pleuro-pneumonia on 1; in October the number of places affected with foot-and-mouth had increased to 161, and in November to 311; but in December it fell once more to 127. The adjoining county is Roscommon, and through it most of the cattle destined for the fair are conveyed by rail or driven by road. Owing to the large number generally sent by road, it is reasonable to suppose that the "distemper" would develop itself a little earlier in that county than at the place of ultimate destination, besides which, important fairs are held in Roscommon itself during August and September. Now, in 1871, no foot-and-mouth was reported as existing in county Roscommon until the month of August, when 56 farms or other premises were returned as affected. In September the number had risen to 165, and in October it reached its maximum of 307. In November the number of affected places had decreased to 171, and in December to 86.

Unfortunately, with regard to the spread of disease in Ireland, we are inclined to take the facts, even when officially stated, *cum grano salis*, and to question every conclusion that might be drawn from them,* in consequence of the too frequent neglect of

* *Ex. gr.*—The reported freedom of Ireland from foot-and-mouth disease during April and May, 1871.

Irish graziers to report the existence of foot-and-mouth disease on their farms. The punishment of this offence, and that of driving affected cattle along a public road, is in many cases made so lenient by the Irish magistrates, that it amounts to an encouragement. I have heard the dealers themselves, when recounting their experiences in getting rid of affected beasts, and their occasional detection, ask one another, as a sort of stock joke, "And were ye fined a shilling?" A most trustworthy correspondent in Ireland has informed me of a case in which, just previous to one of the great fairs at Ballinasloe, a man was prosecuted by the Government, not only for neglecting to report the existence of disease on his premises, but also for driving the affected animals through the town of Ballinasloe. The case was proved; the magistrates fined him *one penny*, and further mulcted him in the sum of *one shilling* for costs! Another and more recent case has been communicated to me from county Meath, in which point was given to the proceedings by the agricultural standing of the magistrates. In this case two men were fined sixpence each for not reporting to the police the existence of foot-and-mouth disease on their farms. Other cases might doubtless be collected, but the foregoing are sufficient to show that infractions of the law are not always dealt with in Ireland with a due sense of responsibility on the part of the local magistrates.

A striking example of habitual disregard of the law may be seen at almost any large railway station in Ireland. By the Transit of Animals (Ireland) Order of May, 1871, it is provided that railway trucks, &c., "used for carrying animals on any railway, shall, on every occasion, after any animal is taken out of the same, and before any other animal is placed therein, be cleansed in the following manner:" (1) swept out, then (2) washed with water, then (3) the sweepings mixed with quicklime, and effectually removed from contact with animals; the wording of these provisions being similar to those of our own "Animals Order, 1871." Then follow two provisions which differ from ours, one ordering disinfection by means of a solution of carbolic and cresylic acid, but not stipulating for the use of lime, and the other enacting that pens or other enclosed places used for confining animals shall be cleansed and disinfected in the same manner as vehicles and trucks, once on every day on which they are used.

I have no doubt that railway trucks are sometimes properly cleansed and disinfected; but although, when in Ireland, I was continually on the look-out for the performance of these processes, they never came under my notice. On the other hand, I have repeatedly seen animals put into trucks that were in the most filthy condition; but I have not heard of an Irish railway company having been summoned for this offence either by the police or the Veterinary Department.

The absence of the provision for a coating of limewash requires a word of explanation, as limewash is probably the most convenient available means of ascertaining at a glance whether the trucks have been cleansed since they were last used. The information given to me was to the effect that the railway companies had memorialised the Government to abolish the requirement relating to limewash on the ground that the proportion of goods-trucks is very small in comparison with the traffic, and that therefore many of the cattle-trucks (I presume the covered ones) are used for the conveyance of goods on the return journey into the interior. The damp climate, especially in the autumn months, when the greater number of cattle are exported, causes the limewash to rub off, not only on the cattle, but on the merchandise afterwards sent in the same trucks. This seems a reasonable explanation of the difference between the Irish and the English regulations, though it may be questioned whether the difficulty could not have been met in another way. However, taking the explanation for granted, it certainly did appear to me that great corporate bodies, like the Irish railway companies, should have considered that they were under a moral obligation to carry out both the letter and the spirit of the regulations which had been thus modified by the Government for their convenience. So far, however, from the companies having accepted the concession in this spirit, it is not too much to say that, on every Irish railway on which I travelled, the regulations as to the cleansing of cattle-trucks were practically disregarded.

In this aspect of the subject it may be useful to call attention to the fact, that the conveyance of cattle is almost entirely a "one way" traffic. In Ireland the direction is from the interior to the coast, and thence to England. Therefore railway-trucks in which the germs of a disease were existent would not necessarily cause a great extension of that disease in Ireland itself; but they would infect the stock *en route* for England, and in the course of a week or two make a very perceptible difference in our returns of affected animals.

At the country stations small cattle-pens are required to confine the stock pending the arrival of the cattle-train by which they are to travel; but at the terminal stations at the ports such adjuncts are not often seen, the responsibility of providing for the cattle on arrival being apparently undertaken either by the steamboat companies or the owners. The railway companies in such cases, as at Cork, Waterford, &c., have, therefore, no cattle-pens at their railway stations; but the steamboat companies have receiving-yards, and the consignees have either lairs or fields, to which the animals are driven on arrival, and where they remain until the time arrives for shipping them. As will be seen in the sequel, the lairs and fields used for such purposes by cattle-dealers are probably some of the most fruitful sources of contagion.

II. The Irish Cattle Trade.

Fairs and Markets.—The cattle-market in Dublin is really excellent, both in arrangement and mode of maintenance. It is divided into longitudinal sections by iron railings, each set of pens being accessible either from the main roadway or a side alley. Offices rented by the salesmen are attached to most of the sets of pens; but of course the sets may vary in size according to circumstances. This was not only the cleanest and best arranged market that I saw in Ireland, but the only one that had any claim to the distinction of a market at all. I was informed that the Corporation of Dublin employ an inspector to examine the beasts exposed for sale in the Dublin market; and I have little doubt that the energetic head of the Irish Veterinary Department does his best to imbue the owners of cattle sent there for sale with a more wholesome fear of the consequences of breaking the law than they are accustomed to receive at home.

Dublin, however, is the only place in Ireland where I saw any properly appointed cattle-market. The place used as a cattle-market at Cork is simply a large field, enclosed by a high stone wall, that at Waterford is one of those open spaces of irregular shape generally termed "market-place," or "market-square." The cattle-fair at Drogheda was held in the streets;* those at Mullingar and Ballinasloe were held on "greens" closely adjacent to the centre of the town, and probably preserved for the purpose as the most valuable use to which the property could be applied. In none of these towns were the market-places or fair-greens divided into pens, nor was any other provision made for the separation of stock belonging to different owners. The only occasion on which I actually saw an attempt at veterinary inspection was at the great October fair at Ballinasloe, although it had been half-expected that the evil reputation which Drogheda had recently acquired as a nest of "distemper," would have induced the authorities to send an inspector to the fair there.

There was no special feature, either at Drogheda or Mullingar, to require description; but if a veterinary inspector had been

* The fortnightly cattle-fairs in many of our small Yorkshire towns are also held in the streets, which, at certain seasons, are crowded with Irish cattle, and are fertile sources of disease.—J. D. D.

sent to either place, he would doubtless have found a considerable number of diseased animals.

The great October fair of Ballinasloe is not only the largest in Ireland in point of numbers of stock sent there, but also the most noted for the quality of the cattle. The yearly records of the progress of foot-and-mouth disease in Ireland, which are admirably arranged in the office of the Veterinary Department in Dublin, show, I believe, that shortly after the period at which this fair is held, the returns of fresh outbreaks of "distemper" suddenly increase to a marked extent. It was therefore gratifying to learn that this year the Government had sent an inspector to Ballinasloe, and that this gentleman possessed exceptional qualifications, and was, as I was informed, invested with ample authority.

The great fair commenced on Tuesday, October 1st. That day and the next were chiefly devoted to the sale of sheep, and it is sufficient to mention that the published returns showed that between 70,000 and 80,000 sheep * had passed through the "gaps," as the entrances to the park of Garbally and the adjacent fair-green are locally termed. The third day was the great horse-fair, but a large number of cattle also arrived in anticipation of the morrow. I arrived at Ballinasloe early on Friday morning, fortunate in the possession of a letter of introduction to the Government Veterinary Commissioner. The immense fair-green was packed with cattle, and it was therefore with great interest that I undertook the task of ascertaining by what means, and with what staff, this immense number of beasts was being inspected. The returns subsequently published showed that there were more than 17,000 cattle † on the fair-green that day. They were not

* The actual numbers were :—

	1871.	1872.
Sold	71,217	63,152
Unsold	12,060	11,250
Total	83,277	74,402

† The actual numbers were :—

	Over 2 years old.		Two year olds.		Calves.		Total.	
	1871.	1872.	1871.	1872.	1871.	1872.	1871.	1872.
Sold	14,885	12,936	1,704	937	114	8	16,703	13,881
Unsold ..	1,129	3,191	0	436	190	0	1,319	3,627
..	16,014	16,127	1,704	1,373	304	8	18,022	17,508

separated into lots by pens, or any other kind of division, and almost every inlet to the fair was a scene of indescribable confusion, owing to the frequent collisions of an ingoing with an outgoing lot of cattle.

The Veterinary Commissioner was most courteous to me under very trying circumstances. As an inspector, he was unassisted; but he possessed and used the power of calling in another veterinary surgeon in the event of any doubt existing in his own mind as to any particular case. When I first saw him he had isolated two lots of cattle in one of the far corners of the fair-green, and he was surrounded by a somewhat excited knot of people, some of whom endeavoured to prove that the cattle were healthy, and others that they had "taken the distemper" in the fair. The inspector had sent for the local Stipendiary Magistrate, and I cannot better describe what took place than by quoting the paragraphs relating to one of the foregoing cases (the other not being mentioned) from the official Report of the Government Veterinary Commissioner:—

"On Friday morning, about 7.30 A.M., I was informed by a county Meath gentleman that some cattle which he had agreed to purchase, while they were in a paddock, on the preceding evening, were standing in the fair, and showing symptoms of disease. On searching, I soon found them in a corner of the green. On making a close examination of them—in conjunction with Veterinary-Surgeon Murphy—I found that some of them were suffering from one of the earlier stages of foot-and-mouth distemper. Among the herd of 83 animals, there were some 7 or 8 showing signs of the disease, such as congestions within and frothing at the mouth, ropy discharge therefrom, incipient vesicles in the course of formation therein, and feverishness pervading the entire system. We could not discover any vesicles between the claws, or near the feet; we, however, determined not to allow the animals back into the fair, but to communicate with you on the subject, which I did by telegraph. But pending your answer, and as a result of consultation with the Sub-Inspector of Constabulary and the local Stipendiary Magistrate, it was decided to require the owner of the lot of cattle amongst which the disease had broken out, to remove them back to his farm, as the distance to it was not long, and the road leading to it was, at that hour, unfrequented. Had there been any delay in the receipt of your answer, the cattle being very large and heavy, it might have become very difficult to remove them when your reply arrived, particularly if the disease rapidly increased towards full development. The purchaser had refused to take them, as they were not in a fit state for removal to his farm, some seventy miles away in the county Meath, giving, also, as a reason for such refusal, that the cattle could not be regarded as his property until handed over to him beyond the custom-gap. This appeared to me a just reason for his refusing to take them; also, if they had been bought the preceding night, they had no business in the fair. I could not allow these animals, consistently with safety, down to the railway station; and, had I enforced the provisions of the Contagious Diseases Act, by declaring the spot an infected space, I should have also had to declare the whole fair-green an infected district; and thus have prevented all moving of cattle, which would have been impracticable. At the hour to which I allude, 9 A.M., many cattle had left, many by the road these cattle had come in by, consequently they would all have been liable to take the disease. And to leave the 83 heifers where they were in a small corner of the fair-green, would have been to leave them to starve, as there were no means of feeding or watering them on the fair-green. To take them to a paddock near and confine them there, would have been no gain to the public, on the score of a precaution against the spread of disease, as to reach any paddock they would have had to pass through a portion of the fair. The amount of mischief done, I considered, had been done while removing them from the paddock in which they had passed the preceding night, although their owner, who I heard is a very respectable man, declared that none of these cattle showed any signs of disease on the previous evening, nor until it was observed amongst them in the fair on that morning, nor have I any just cause to doubt his word.

"The usage of Ballinasloe fair is so vague that it was difficult to decide who was the owner at the time the disease appeared, and who was the responsible party to prosecute. Their owner, however, offered to take them home; and as his farm was only eight miles off, along a country road, I decided in sending them there, but in charge of the constabulary. This was accordingly done. During that day I discovered no other cases that called for my interference."

The law relating to such cases is clearly set forth in sections 3 and 13 of the Order of the Irish Privy Council, dated November 3rd, 1870, and generally known as the "Foot-and-Mouth" or "Distemper" Order. The provisions of section 13 are so clearly impracticable, that one is, if possible, even more surprised that it should have been in the first place enacted, and afterwards allowed to remain unrevoked for two years, than that the authorities at Ballinasloe declined to carry them out.

The sections are as follows:—

"3. The words 'an infected place or district,' according to this Order, shall mean or signify any field, stable, cowshed, premises, or other place on or in which there is or has been at any time within the immediately preceding ten days, an animal affected with, or labouring under foot-and-mouth distemper, or the apthous disease, and the adjoining lands, buildings, premises, or places in the same occupation, or with or through which, from it or them, there is a communication of passage which is not a public road."

"13. No animal affected with foot and mouth distemper, or the apthous disease, shall be moved alive from any lands, premises, or place while so affected, and no animal which has been in contact or herded with an animal so affected, shall be moved from any lands, premises, or place, except for immediate slaughter, and under a licence obtained in that behalf, and in the form set forth in Schedule 2 of this Order, from the officer in charge of the nearest constabulary or police station; and every person obtaining such licence, and removing, under the same, animal or animals specified therein, shall proceed immediately to slaughter the same, under the penalty of being deemed to have offended against this Order. And the owner of every slaughter-house in which such animal or animals has or have been slaughtered, or his agent, shall, within forty-eight hours from the time of slaughter, forward to his licenser a certificate in the form in the Schedule 2 of this Order set forth, under a like penalty."

Having naturally felt great interest in the solution of the problem thus presented to the authorities, in consequence of a county Meath gentleman having informed the Government Commissioner that a certain lot of cattle showed symptoms of disease, I followed the case through its various stages. By noon, I found that the identical corner of the green where the lot of 83 had been stationed previous to their dismissal had been taken possession of by another consignment; and it appeared, not only to me, but to an agricultural friend, whose experience ought to constitute him an authority, that both the new arrivals and a large number of other cattle, as well as some of the few remaining sheep, were affected in no slight degree. We selected one ewe of the blackfaced Scotch breed that exhibited very marked symptoms, and on examination detected the blushed mouth in so distinct a condition that it was worthy of being sketched.

The accounts of the cattle-fair that appeared in the newspapers the next day contained a sentence to the effect that "one case of distemper was discovered by the Government Inspector." The Commissioner himself disposes of the question in the following paragraph in his Report, dated five days after the fair:—

"In conclusion, I am satisfied a great and exaggerated notion prevails among the public generally with regard to the amount of disease at the last Ballinasloe fair. That there were no cases of contagious disease in the fair besides those already referred to among the one lot, is more than I am prepared to state, owing to the hurried nature of my inspection; but I am satisfied that acute cases were few. Among the numbers of stock that I have passed on the roads since the fair, few showed symptoms of any disease, except soreness of feet from driving; but foot-and-mouth distemper being at present so widely spread in all parts of Ireland, stock may take it any where, and at any time, when going along the roads. The disease certainly did not originate in the late fair of Ballinasloe; and, as I stated to you in my communication last week, I consider, unless precautions are rigidly enforced at an earlier season, it is useless, at this time of the year, when the disease has been so long raging, to do more than prevent stock in a very acute stage of the disease from being moved about the country."

It would be instructive to learn what was the influence of the Ballinasloe fair of 1872 on the spread of foot-and-mouth disease in England and Ireland. Nothing can be ascertained with regard to England in the absence of any machinery for the purpose; but the publication of the returns for 1872, on the plan of Tables V. and VI., will enable us to estimate the result for Ireland. That it must have been very considerable is the conclusion at which I arrived; and it was subsequently strengthened by reading the following paragraph in the 'Irish Farmers' Gazette,' of November 2nd:—

"Foot-and-mouth disease has re-appeared in different parts of the county of Longford. At the late Ballinasloe fair a gentleman named Mr. Russell, residing about four miles from the town of Longford, purchased several hundred head of cattle, and had them grazing on his land. About a week ago he discovered that they were affected with the disease. He has already lost about 50 animals, and on Tuesday se'nnight alone 13 of them died."

The paragraph is not dated, and "a week ago" is probably a misprint for "a week after." From the date of the paper containing the paragraph, Tuesday se'nnight would be October 22nd, or 18 days after the cattle-fair at Ballinasloe.

In a subsequent number (16th November) a correspondent states that, in his neighbourhood, "all went well till Banagher fair. That fair, and Ballinasloe also, was full of diseased animals, and now the whole place is full of it, from stock purchased, or brought home unsold."

The bearing of such facts on the general question of the greater prevalence of foot-and-mouth disease during certain months of the year has been discussed in a previous portion of this Report (pp. 190 and 201).

Inland Transit.—Ballinasloe fair may also be taken as a good starting point for an illustration of the conditions incidental to the cattle-traffic between England and Ireland, because with regard to it the subject can be taken up at the point where it was left by the Government Commissioner in charge of the inspection, and the advantage is thus gained of commencing from an official basis. The Commissioner reports as follows:—

"On Thursday, the 3rd October, I found great numbers of cattle in and about the fair showing symptoms of exhaustion and foot-soreness, owing to the extreme heat of the day, and to having been overdriven; but in no instance could I discover vesicles between the claws or in the mouths of any such footsore or lame animals. Those that slobbered at the mouth did so in the usual manner of cattle suffering from exhaustion; but in such cases there was an entire absence of the peculiar slopping or sucking noise characteristic of genuine foot-and-mouth distemper."

The cattle-fair was, as already stated, held on Friday, the 4th October.

How the cattle that arrived the day before fared for food and water, I cannot say. The probability is that they got neither, as the fair-green was too poached to afford any herbage, and there was no provision, so far as I could ascertain, for watering cattle on it. It is not likely that the drovers, having once got their beasts on the green, would drive them off again in search of food or water; and it is certain that the arrivals during the ensuing night and following morning must have been compelled to make their last meal sufficient for their wants until they arrived at their new destination. Supposing their destination to be England, the course of events must have been very nearly what I am now about to describe.

Most of the cattle which exchanged hands had been bought by noon on the 4th October, and the energies of the purchasers on English account were by that time directed to obtaining an appropriation of trucks for the conveyance of their stock to North Wall. Their drovers were busy driving the cattle to one of the numerous strips of land adjacent to the railway, which had been hired by the Company for the temporary reception of stock coming to and going from the fair. There was no provision for giving water to the cattle in these hoof-poached paddocks, for the Transit of Animals (Ireland) Order does not compel railway companies to have water-troughs at their cattle-sidings; and although the swollen Suck was flowing at a very trifling distance from the station, I did not see a single lot of cattle driven to the river-side. This might not have been the fault of the owners or the drovers, for I was unable to ascertain whether there was any convenient public approach to the stream from near the railway-station. However, the points to be kept in view are these:—1st, the railway company did not supply their pens and paddocks with troughs of water; and 2nd, the cattle had to commence their journey without that refreshment, after having already been kept, in all probability, at least 24 hours without food or water.

Arriving in Dublin on the Friday evening, I ascertained that cattle from Ballinasloe would probably reach North Wall in a more or less continuous stream during the night and the next day; and as many as possible would be put on board the steamboats timed to leave for the various English ports by the morning and evening tides on Saturday. The probability of their being fed and watered in the receiving-yards belonging to the various railway and steamboat companies is, as will presently be seen, very small indeed, except in the yard belonging to an English railway company.

As a matter of fact, therefore, the majority of the cattle bought at Ballinasloe fair for exportation to Great Britain were not fed or watered from Thursday until Sunday, at the earliest. Those that were sent by the London and North-Western Railway Companies' boats, *viâ* North Wall and Holyhead, doubtless obtained water, and perhaps a little hay, on Saturday morning at North Wall, and at Holyhead on Saturday night or Sunday morning. The remainder were shipped to Liverpool, Bristol, Glasgow, and other ports, without having had food or water for at least two days, during which they underwent the fatigue of the journey by road or rail to Ballinasloe, that of standing in the fair and the railway paddock nearly all one day, if not part of another, and that of the railway journey from Ballinasloe to Dublin (92 miles). After their two days' fast and fatigue, they had to stand in the hold of a steamboat during a sea-passage varying in duration from 12 to 24 hours, and to undergo the hardships incidental to the shipment, to the passage, and to the subsequent landing, before receiving even a drop of water.

I have taken Ballinasloe fair as the starting-point of this part of the subject simply because there is official evidence of the condition of the cattle on their arrival; but what is true of

Ballinasloe is doubtless true of every fair and great market in Ireland, the only essential difference being the greater or less time during which the animals are kept in a starving condition, as that of course varies with the distance, and the facilities of communication, between the place of origin of the cattle and their port of destination in England.

It therefore seems to me that, as a matter of humanity as well as of commercial expediency, a detention in the receiving-yard of the steamboat company should be enforced by law sufficient to allow of the feeding and inspection of the stock previous to their shipment to England. Many objections have been urged against this view, but those who read this report will probably be able to estimate their value after considering the facts relating to inspection in England, by the light of the knowledge of the results of inspection on the Continent.

Irish Ports.—More than one-third of the total number of animals exported from Ireland * are sent by way of Dublin; and lines of steamers ply regularly between the North Wall and Liverpool, Holyhead, Bristol, Glasgow, Silloth, and other ports. No record is kept of the ports of destination of animals exported from Ireland to Great Britain, but there can be no question that by far the largest proportion of the consignments of live stock from Dublin go to Liverpool and Holyhead. I therefore devoted particular attention to the arrangements connected with these lines of communication between Ireland and Great Britain. Cattle, sheep, and pigs exported *viâ* Dublin are either purchased in the cattle-market on the market-day (Thursday), or they are sent from the inland fairs, markets, and farms by road or rail. Formerly, all animals intended for shipment to England were of necessity driven either from the cattle-market, or the various railway stations, across the middle of the city; but recently the Midland Great Western Railway of Ireland has extended its line to North Wall, and thus a great amount of unnecessary driving and cruelty has been obviated.

When animals intended for shipment to England arrive at North Wall they are taken to the receiving-yard or lair belonging to the steamboat or railway company by whose route they are to be sent. These yards abut against the roadway of the quay, and are adjacent to the offices of the several companies. I cannot say that I have seen every receiving-yard of the kind in Dublin, but I have examined enough to enable me to state that they belong to two categories, one exceedingly good in arrangement and mode of

* These were as follows, in 1870, 1871, and 1872 :—

	Oxen, Bulls, and Cows.	Calves.	Sheep and Lambs.	Swine.
1870	415,673	38,296	620,834	422,076
1871	423,396	60,529	684,708	528,244
1872	(Cattle) 616,080	..	518,606	443,644

maintenance, and the other precisely the reverse. In the first class I would place the receiving-yard belonging to the London and North-Western Railway Company, and I regret that no other yard in Dublin that has come under my notice is worth classifying with it. This yard is commodiously divided into pens for horned and other stock, the latter being covered with substantial roofs. All the divisions are kept thoroughly cleansed and whitewashed, and each pen is furnished with a drinking trough. This is precisely what a receiving-yard for live stock should be; and it seems only fair to assume that what an English railway company can afford to do in Ireland, is not beyond the means of Irish steamboat companies doing a large carrying-trade to the principal ports on the western coast of Great Britain.

The next yard to that just described is a large square open piece of ground with two water troughs near one corner. In the absence of any permanent pens for the reception of cattle or sheep, the interior of this yard would have a desolate appearance, but for the fact that it is, to a certain extent, diversified, though not decorated, by an accumulation of empty boxes, barrels, and crates, which are turned to useful account by the drovers as mobile temporary divisions between their several herds. As there is no inspection of animals while they rest in the receiving-yard, or at any other time previous to their shipment from Ireland, except, perhaps, in the Dublin market, it may easily be understood that a yard managed in this manner must become a nest of disease. The passage from Dublin to Liverpool is generally about twelve or fourteen hours in duration. Supposing that a beast imbibed the germs of foot-and-mouth disease in the receiving-yard in Dublin, it would, in the absence of inspection at Liverpool, pass inland without detection, and in all probability would affect a hundred or more other cattle either in the steamboat, on the railway, or in the market, before the existence of the disease in the infecting animal was discovered, either by the consignee or by the veterinary inspector of the local authority on the market.

There is no inspection of animals previous to shipment, either at Dublin or any other Irish port; but a policeman would probably stop any that were evidently in an advanced stage of disease. The London and North-Western Railway Company have also adopted a system of scouts, as a rough kind of substitute for inspection. The men thus employed have an empirical knowledge of the appearance of an animal affected with foot-and-mouth disease; and if they suspect any that are about to enter the Company's receiving-yard, they signal to the gate-keeper, the gates are closed, and the suspected animal is turned into a separate yard until examined by a veterinary surgeon. Connected with this receiving-yard, but separated from it, is a hospital-shed for the reception of diseased animals.

These excellent arrangements are made by the London and North-Western Railway Company as a matter of business. The manager in Dublin is convinced that a humane and rational method of conducting the traffic is not only possible, but in the long run remunerative. Following out his system, the men employed in this receiving-yard do not object to give water in moderate quantities to the cattle previous to their shipment, provided that a small quantity of hay is allowed first; but other people object to giving water, on the ground that it induces scouring during the passage. No doubt beasts that have been kept for two or three days without food or water will drink an immoderate quantity in the receiving-yard, if allowed to do so; and if this water is taken without food being also given, the cattle will almost certainly suffer from scouring. Thus, water, which costs nothing, is not given, because the dealers will not go to the expense of a little hay. I am strongly of opinion that all receiving-yards should be divided into convenient pens for each description of live stock, that all animals should receive food and water there previous to shipment, and that they should invariably be examined by a Government Inspector during the period of rest afforded by the necessity of feeding them.

The arrangements at Drogheda, Cork, and Waterford do not differ in principle from those at Dublin. Drogheda seemed to me to merit its unenviable reputation as a centre of disease; but I found the receiving-yards at Cork and Waterford far better kept than previous experience had led me to expect. The great fault is, that cleansing and disinfecting materials are not made sufficient use of in most cases; while some yards are never cleansed further than to the extent incidental to the collection of the dung, which is sold periodically.

It would not be just to the Great Western Railway Company, however, if I did not state that their business at Waterford is carried on in the same enlightened spirit as that of the London and North-Western at Dublin. Further than this, the Great Western Company, I was informed, are now building steamboats of a superior character, and otherwise exerting themselves to put their cattle traffic in the south of Ireland on a thoroughly satisfactory basis. In particular, I may mention that a series of experiments have been made to test the practicability of establishing a large dead-meat trade with Ireland at all seasons of the year, one feature of which is the use of Ash's patent self-ventilating railway-van, which keeps the air free from dust, and at a steady temperature throughout the journey. The probable results of so important an experiment cannot yet be inferred; but if they should lead to the voluntary slaughter of all fat stock, both foreign and Irish, at the port either of shipment or landing, without enhancing the cost of meat to the consumer, the difficulties now connected with the proper regulation of the trade in animals will be very much diminished.

The Western English Ports.—Bristol.—The city of Bristol—that "*fons et origo mali*" of the West of England newspapers—and the surrounding district have, probably, fairly earned almost every bad word that has been spoken or written against the great market of the West. So strongly, indeed, is it felt that Bristol Market is the plague-spot of the district, that the Somersetshire magistrates assembled in Quarter Sessions have endeavoured to obtain, from the Privy Council, authority to enact that all animals going into Somersetshire from Bristol Market, or through the city of Bristol, should be isolated by the farmer from the rest of his stock for a period of nine days, and that the purchaser of such stock should give notice to the nearest policeman of his having bought animals that had come from or through Bristol.

Previous to the great autumn fair, I visited Bristol for the purpose of witnessing the arrival of the Irish cattle that were sent there for sale. They were landed from the Irish steamers on a broad quay at Cumberland Basin, provided with two or three large water-troughs, well whitewashed, and otherwise scrupulously clean. Watching the operation of unloading were the Government veterinary inspector and an officer of the Royal Society for the Prevention of Cruelty to Animals; but it was, nevertheless, difficult to prevent cruelty and to keep matters going smoothly, owing chiefly to the absence of policemen, except at rare intervals,—the whole of one side of the Cumberland Basin being in charge of but two constables. As a consequence, the drovers took to fighting, and the cattle were landed without proper manual assistance. Out of one cargo, I saw one beast dislocate its shoulder, and others receive injuries of a less serious nature. No fault could be found with the landing-place, and the cattle had plenty of time and opportunity to assuage their thirst. Several animals, especially pigs, were apparently suffering from foot-and-mouth disease; but the Government inspector assured me that he had no jurisdiction except over foreign animals, while the inspector of the local authority was not on the quay. As soon as the cargoes were discharged, the process of cleansing the steamboats commenced, according to the regulations of the Privy Council, and under the superintendence of the Government inspector. In no other port did I observe that this important provision was so thoroughly complied with as at Bristol.

The Irish stock arrived chiefly on Saturday, and the fair was held on the following Monday, in the ordinary cattle-market. The market-place is a large square, surrounded by a stone wall, well paved with stone, and divided into sections by low walls, also of stone. It is furnished with a good-sized circular drinking-trough, and is from end to end almost better kept than any other market-place I have yet seen, in the United Kingdom or on the Continent. The walls are frequently white-washed, and, after the manure is removed, the paving is plentifully bestrewn with lime. The cattle in the fair were exclusively Irish, with the exception of one lot. They were carefully examined, as also were the sheep, by the veterinary inspector of the local authority; but it was evidently too much work for one man to do properly within the available time. It occurred to me that much good would result if the distinction between Government inspector and local inspector were abolished, and if either the local or the central authority appointed a chief inspector and a subordinate, the Government paying the whole or part of the salary of the former, on condition that he was to be held responsible for the proper discharge of the duties now performed by the Government inspector. In this manner two veterinary surgeons, instead of one, would be available for the examination of stock in the fair, or on the weekly market, and there would be little, if any, additional expense either to the local authority or the Government.

The inspector of the local authority at Bristol assured me that he had not seen a case of foot-and-mouth disease in the market for more than two months previous to the fair, and there were none to be detected in the fair. I took the names and addresses of six gentlemen who bought stock at the fair, as a sort of check to this statement; but in no case was it clear to me that their purchases took the disease to the farms to which they went. The only inference that could be drawn from so slight an experience was that stock bought at Bristol Market are not so uniformly diseased as has been asserted.

There can, however, be little doubt that Bristol is the great centre of infection in the West of England; and, if the market is blameless, some other portion of the arrangements must be defective. I therefore carefully traced some beasts from an Irish steamboat to the market, with a view of ascertaining what became of them in the interval, and of judging whether the secret was hidden in the place of their retirement. I thus found that, after the cattle had been landed and watered, they were driven to certain fields conveniently situated near the boundary of the city jurisdiction, some being within that boundary and some outside it. These fields are rented by cattle-salesmen, and they are used as a temporary refuge for stock which arrive between the market days. On the morning when the stock are driven to the market, any animal appearing to be lame, or otherwise showing symptoms of disease, would be left behind in the pasture; but the others, though they had been in contact with the diseased animal, would be sent to market if the contagion had not developed itself sufficiently for detection by the inspector. The magistrates of Bristol are, I was informed, so strict in their administration of the law, that some of the salesmen are said to employ a veterinary surgeon to examine their beasts previous to sending them to market. In this way they escape the penalties imposed by the magistrates, according to the Act, on the owners of manifestly diseased animals sent to the market; and at the same time they sustain the evil reputation of Bristol by sending there animals that have been impregnated with disease, but have not developed it sufficiently to be detected by the veterinary inspector.

This practice is not confined to Bristol,* for it exists at most of the ports of shipment in Ireland, and at those of landing on this side of St. George's Channel. But, owing to the prevailing absence of inspection at the Irish ports, fairs, and markets, there is naturally less care exercised in the examination of the animals previous to removing them than there is in England. It may be urged that here we have conclusive evidence of the uselessness of inspection; and, as the law now stands, the statement would be perfectly accurate. But if all fields, farms, and other premises used by salesmen for the temporary reception of live stock were certificated and registered; if the veterinary inspector had the power of entry into such places, and were required to exercise it, for the purpose of ascertaining whether diseased animals were kept there, much might be done to prevent the spread of infection from these nests of disease. With such an alteration of the law, the inspector should, on discovering the existence of disease in such premises, declare them to be infected in reference to the particular disease that he found to prevail; and the local authority should then prohibit the ingress of any other stock into them, and the egress of any stock from them, until a sufficient time had elapsed after the date of the inspector's certificate of freedom from infection. If such regulations were made, and properly carried out, it would not surprise me to learn that the Somersetshire magistrates had discovered several "fountains of disease" in the parishes of Knowle and Long Ashton, and that the prohibition of egress of stock from such premises until ten days after they had been certified to be free

* The same thing occurs in Yorkshire. I know one field that was used for some time during the autumn in this manner, and which was never free from infection.—J. D. D.

from disease, would be more effectual in controlling the spread of foot-and-mouth disease than the isolation of animals bought in Bristol Market.

It is, however, quite as necessary that this should be done in Ireland as in England, because disease is propagated by the same means in both countries, and frequently animals bought in Ireland go direct to the English farmer without coming under the cognizance of a local authority, because they are not exposed for sale in a fair or market. Several purchasers of such stock have testified to the fact that they have taken foot-and-mouth disease with them to their English home, thus giving a direct negative to the oft-repeated assertion that Irish stock take foot-and-mouth disease in our English fairs and markets.

Liverpool.—While at Bristol very great attention is paid to the cleanliness of the cattle-market and of the steamboats, this cannot be reported of Liverpool. There are no water-troughs at the usual landing-places, but the Irish cattle are driven, immediately after debarkation, either to the railway receiving-pens (where water-troughs are provided), or to the premises in the occupation of the consignee. The cattle-market is situated at West Derby, some distance from the docks: it is very well arranged, on a similar plan to the Dublin cattle-market, but is exceedingly dirty and somewhat dilapidated, with a rickety pavement and defective drainage. It is entirely a fat-stock market, otherwise it could not fail to be a great focus of disease. The salesmen pay a stipulated rent per annum for their office, and they generally occupy the same sets of pens, paying the regulation toll per head of cattle and per score of sheep. This is a very good plan, and, if properly carried out, must simplify the duties of the market authorities. In reply to my inquiries as to inspection, I was informed that two veterinary inspectors are employed, and a number of police to assist; and my informant added that the police inspect as much as the veterinary surgeons, because, as all the cattle would soon be killed, the inspection is only a matter of form. However, it seemed to me that a diseased animal might very possibly not be sold, and would in that case be sent back to the salesman's fields, and infect any number of dairy or store stock intended for the markets of Cheshire, Lancashire, and Yorkshire. Moreover, although there is a very good slaughter-house in the vicinity of the market, the authorities of West Derby will not license it; therefore it is impossible to kill diseased animals without first driving them to a slaughter-house along roads which may communicate the infection to the next lot of stock driven along them.

Such facts as these seem to demonstrate the necessity of a system of supervision over cattle-dealers, however repugnant it may be in principle to our ideas of individual liberty. That cattle-dealers should be known, it seems necessary that they should be required to take out a licence; and that the premises used by them for the temporary reception of stock should be registered, it is necessary that they should be certificated. By these means, and with the aid of the veterinary inspector of a local authority reporting any salesman, who should exhibit diseased beasts, to the local authority of the district in which he holds or occupies fields, lairs, &c., in order that such premises may be properly examined, with a view to ascertain whether the stock in them are also affected, much might be done to prevent fairs and markets continuing to be the great *foci* of contagion.

The arrangements at Liverpool for the landing of foreign animals are the most unsuitable that I have yet seen at any large port. There is no permanent provision even for the reception of animals, but certain of the dock sheds are certificated for the purpose. The consignees of a cargo of foreign animals arrange to hire one or more of these, or a part of one. The cattle are fed with hay, which is strewn on the floor, and are watered in moveable troughs supplied by a hose from the fire-plug. The sheds are afterwards cleansed by the hirers, and the next day they may be used for storing grain, sugar, or any other commodity. Considering that 16,071 foreign animals were imported into Liverpool in 1871, it seems incredible that there should be no better provision for their reception and detention until after inspection. About one-half of these animals were German sheep, and the remainder were cattle from Spain and Portugal—the two unscheduled countries from which we import by far the most considerable number of animals affected with foot-and-mouth disease. It would be interesting to learn how such diseased animals are dealt with at Liverpool, and I regret very much that I have not been fortunate enough to see a cargo landed and inspected, and am therefore unable to describe the proceedings from personal knowledge.

Other Western Ports.—Holyhead and New Milford are merely resting-places for Irish stock after landing, and before commencing their railway journey. The companies do everything that can be expected of them under existing circumstances; but it should, in my opinion, be compulsory on them to supply the animals with food at such places at the cost of either the sender or the consignee.

Cardiff, on the other hand, is what may be termed a port of ultimate destination, as the stock sent there are either fat cattle, &c., which are slaughtered in the town, or stores, which are fed off by the South Welsh farmers. The principal trade between Cardiff and Ireland is with Cork; and it so happens that there is comparatively little foot-and-mouth disease in the Cork district. The trade with Cardiff is said to be principally in the hands of small jobbers at Cork, who drive their stock twenty or thirty miles to the port, instead of sending them by rail, and thus avoid the danger of infection in the railway-trucks.

The landing-place at Cardiff is, very much like that at Bristol, on a small scale. It is furnished with a good water-trough, but no lairs or pens, and is in other respects a miniature representation of Bristol. After having been landed and watered, the cattle are driven to the premises of the consignee or to a slaughter-house in the town.

There is no cattle-market in the town of Cardiff, as the Canton Market Company (Canton being a suburb of Cardiff) have the monopoly of the trade in horned stock. There is, however, a market for sheep and pigs in the town, and adjoining it is a slaughter-house, as well as a receiving-house for cattle intended for slaughter in the adjoining building. In the event of a beast being sent to the receiving-house and taken away again instead of being slaughtered, the owner has to pay a small fee. Thus the receiving-house may be made a kind of repository or market; and I was informed that a large number of cattle were bought and sold privately in this manner. As none of these premises appeared to be properly cleansed and disinfected, I inferred that a certain proportion of the foot-and-mouth disease in South Wales might be traced to this source.

On inquiry, the inspector of the local authority informed me that pigs are sometimes kept in this market for a fortnight or more before being killed, and that a great number, if not affected when brought to the market, develop foot-and-mouth disease before they leave it. As store sheep and pigs are brought to the same market every Saturday, they may take the disease with them, and spread it all about the country. On his representation of these facts to the Cattle Plague Committee of the Corporation, they ordered hose to be supplied, so that the whole of the market-place should be washed out after every market-day, and afterwards disinfected with either carbolic acid or chloralum. I could not ascertain, however, that this was regularly done; and, in my opinion, such things rarely will be done, unless they are rendered compulsory on the part of the local authorities, and unless the Government send a qualified inspector, from time to time, to see that the regulations are properly carried out in the different market-towns of the country.

The cattle-market at Canton is situated outside the jurisdiction of the corporation of Cardiff. Except at fair times, it is evidently far too large for the requirements of the district, being merely supplementary to the sheep and pig-market, and the receiving-house for cattle, in the town itself. It bears marks of not being frequently cleansed and disinfected, and the abundant crop of grass on it appeared to me the natural effect of successive doses of manure. Adjoining it is a large paddock, used for the temporary reception of beasts intended for sale at the next market.

III.—The Foreign Cattle Trade.

The trade in animals with foreign countries is complicated by the necessity of restricting free importation (subject to inspection of the animals) to countries which have been free from cattle-plague for a certain period, and which do not permit the importation of cattle from other countries in which cattle-plague has existed within the period deemed necessary for the destruction of the germs of contagion.

For this reason, foreign countries which export live stock to England are divided into two classes—namely (1), the scheduled countries, animals from which are killed at the port of landing; and (2), the unscheduled countries, animals from which must undergo a quarantine of at least twelve hours at the port of landing, and must then be examined during daylight by the Government veterinary inspector; if found healthy, they may be moved inland, but if any animals are found affected with any contagious or infectious disease, either the diseased animals or the whole cargo may be immediately slaughtered at the port of landing. The animals from scheduled countries are landed within a specified circumscribed area, known as the "defined part of the port," beyond the confines of which they are not allowed to pass, and within which they must be slaughtered within ten days, exclusive of the day of landing. Animals from unscheduled countries are landed at any other convenient part, and are supposed not to come into contact with other animals until after their inspection and their release as healthy animals, after which they are regarded by the law, to all intents and purposes, as British animals. But all animals, whatever their origin, breed, or nationality, going within the confines of the "defined part" of the port are immediately dealt with as if they had come from a scheduled country, that is to say, they are not allowed egress from the "defined part" except as "dead meat."

It is necessary to draw this distinction, because the influence of the trade in foreign animals on the spread of foot-and-mouth disease depends almost entirely upon the number and condition of the animals imported from unscheduled countries, and scarcely at all upon either the number or the condition of those coming from scheduled countries, because the latter are slaughtered within the defined part of the port at which they are landed.

As the statistics for the year 1872 are not yet available, it is necessary to illustrate this paper with those for 1871, being the last complete year previous to the investigation made during last autumn. The figures are as follows :—

TABLE VII.—IMPORTATIONS of Stock from Scheduled Countries in 1871.

	Cattle.	Sheep.	Pigs.	Total.
Belgium	301	104,394	2,099	106,794
France	..	24	1,709	1,733
Germany*	77,144	491,127	36,045	604,316
Russia	270	60	44	374
	77,715	595,605	39,897	713,217

TABLE VIII.—IMPORTATIONS of Stock from Unscheduled Countries in 1871.

	Cattle.	Sheep.	Pigs.	Total.
Denmark	16,411	13,402	3,018	32,831
Holland †	106,186	304,417	41,850	452,453
Norway	1,020	2,129	41	3,190
Portugal	20,462	37	8	20,507
Spain	19,984	30	13	20,027
Sweden	5,615	633	131	6,379
Other countries	33	24	655	712
	169,711	320,672	45,716	536,099

Now the question which bears most closely on the object of my investigation is clearly, How many of these animals were found to be affected with foot-and-mouth or other contagious diseases on their arrival in this country, and from what class of country did they come—the scheduled or the unscheduled? The Report of the Veterinary Department of the Privy Council

* Sheep and goats from Germany were removed from the "Schedule" on the 20th April, 1871; but the figures here given include the importations for the whole year.

† Cattle brought from the Netherlands were under the operation of the "Schedule" until the 20th April, 1871; but the figures here given include the importations for the whole year.

for 1871 (p. 27) enables me to answer this question with precision as follows:—

TABLE IX.—NUMBER of Imported Animals found affected with Foot-and-Mouth Disease in 1871.

	Cattle.	Sheep.	Pigs.	Total.	Percentage of Importations.
SCHEDULED COUNTRIES:—					
Belgium	..	..	183	183	·171
Germany	88	62	69	219	·036
UNSCHEDULED COUNTRIES:—					
Spain	292	..	..	292	1·4
Portugal	201	..	..	201	·98
Holland	..	4	..	4	·0009*

TABLE X.—NUMBER of Imported Sheep found affected with Scab in 1871.

	Number of Sheep.	Percentage of those Imported.
SCHEDULED COUNTRIES:—		
Belgium	343	·328, or about 3¼ per 1000
Germany	2642	·538, or about 5⅓ per 1000
UNSCHEDULED COUNTRIES:—		
Holland	10	·003, or about 3 per 100,000
Valparaiso	2	

In addition to the foregoing, 1 German and 5 Dutch beasts were discovered to be affected with pleuro-pneumonia during the year 1871.

The figures relating to Holland prove that it is quite possible to render inspection efficient. If the same high standard of efficiency is not always maintained in a country, it must be owing to a laxity on the part of the authorities, such as is not unfrequently bred by immediate success. However, the monthly reports published by the Veterinary Department during 1872, stating the number of foreign animals brought by sea to ports in Great Britain, which by inspection on landing were found to be affected with a contagious or infectious disease, show that during the whole of the year Holland sent us 181 cattle, 18 sheep, and 40 pigs affected with foot-and-mouth disease, 1 beast with

* Not quite one in 100,000.

pleuro-pneumonia, and 9 sheep with sheep-scab. The importations from the Netherlands last year amounted to 58,286 cattle, 239,734 sheep, and 9871 pigs, so that rather more than 3 cattle in every thousand, or 8 animals in every ten thousand of the total imports, were on inspection in England found affected with foot-and-mouth disease. These facts seem to prove that, if proper care is exercised in the inspection of animals, previous to shipment and after landing, the risk of importing a disease like foot-and-mouth, is reduced to very small proportions.

Foreign Ports—Hamburg.—The shipping-stage for cattle at this port is provided with the best covered lair that I have seen, with the exception, perhaps, of the London and North-Western Company's yard at Dublin. It is entirely covered by a double-span roof; and cattle intended for shipment are said to be examined here by the Government inspector. Unfortunately, the returns of cattle found affected with contagious or infectious disease on their landing in England show that the inspection at Hamburg and other German ports is not so efficient as it might be. This laxity is to some extent explained by the fact that so long as a country is scheduled by the English Government there is less care devoted to the detection of disease in the exporting country than there otherwise might be, because it is felt that the animals will be slaughtered at the port of landing in any case, and that nothing worse can happen to them under any circumstances. So long as countries are scheduled or unscheduled simply on account of the possible danger of cattle-plague, this kind of inattention to the detection of foot-and-mouth disease must be expected to continue; but if, over and above the precautions now taken with reference to cattle-plague and sheep-pox, it were insisted upon by the English Government that efficient inspection with reference to pleuro-pneumonia, foot-and-mouth disease, and sheep-scab, should be an indispensable condition to free entry of live stock imported from foreign countries, a great improvement would doubtless ensue. We might then, for instance, in a short time import Spanish and Portuguese cattle free from foot-and-mouth disease, whereas, in 1871, so large a proportion of cattle affected with it arrived from those countries, that they ought to have been scheduled in consequence.

The Hamburg cattle-market is situated outside the limits of the town, and is arranged on the same plan as the Dublin and Liverpool markets; but the offices are more conveniently placed, and each is marked with the name of the dealer who rents it. In the neighbourhood of the market are extensive ranges of cattle-sheds belonging to the dealers, and used by them for housing their stock before sending them to the shipping-stage, or to the market, as the case may be. At the time when I was in

Hamburg these cattle-sheds were in greater request than usual, because no cattle could be sent into the fields in a certain district, for fear of their becoming infected with the cattle-plague.

The cattle, sheep, and pigs which arrive at Hamburg by railway are either penned at the station previous to being sent to the market, or are driven to the cattle-sheds belonging to the owner. The railway-pens are very extensive, and seemed to be used for keeping animals a considerable time. But the same objection exists against these pens and cowsheds as against the fields occupied by the English and Irish salesmen, namely, that diseased animals may be left behind and infect others. They have, however, the advantage of being easily cleansed and disinfected, whereas in the case of fields that is impossible.

The outbreak of cattle-plague at Hamburg, and the vigorous manner in which the disease had been stamped out by the authorities, were matters of great interest at the time of my visit; I therefore drew up the following brief sketch, from information kindly given me by the British Consul and other gentlemen who had personal knowledge of the circumstances.

On July 23rd cattle-plague was discovered to have broken out on a farm in the neighbourhood of the town, and a cow died from it on that day. A cordon of police was immediately drawn round the infected place, and ten beasts which were included within it were immediately slaughtered. The farmhouse was also included within the police-cordon, and the farmer and his household were compelled to undergo forty-eight hours' quarantine before they were admitted outside the line of investment. At the regulation distance (I believe about a mile) beyond the police-cordon, was an outer circle of military, and no person who went within that line could come out until after he had been carefully disinfected. No domestic animals, whether cattle, sheep, pigs, dogs, or horses, were allowed to pass the military line under any circumstances. People whose business compelled them to pass it (the inner line was kept unbroken), such as veterinary inspectors, police, and other officials, were disinfected previous to repassing it in the following manner :—The person was placed in a kind of sentry-box, having a perforated platform inside for him to stand upon, and an orifice in the door large enough to receive the greater portion of the face, or, at any rate, the mouth, nose, and eyes, thus preventing suffocation. Beneath the platform was a large vessel containing one of the preparations used for obtaining large quantities of free chlorine gas. Chemical action having been set up, the door was firmly closed, and the gas escaped in dense clouds into the sentry-box, penetrating the clothes and hair of the person inside, and thoroughly destroying (as is believed) any germs of disease that may have become attached to him. Notwithstanding these precautions, the plague burst through the military cordon on two occasions, to a distance of not quite a mile each time. Altogether 4 animals died and 100 were killed in consequence of their contact, or supposed contact, with the diseased beasts. The last case of slaughter was on August 26th, a little more than a month after the first case of Rinderpest was discovered; and on September 18th the district was declared free from disease. Although more than three weeks had thus elapsed since the slaughter of the last suspected animal, the time was apparently not long enough for the destruction of the virus, as the Rinderpest was shortly afterwards said to have again appeared at Hamburg; but I am not acquainted with the details of this fresh outbreak.

The essential differences between the foregoing method of proceeding and our own will be at once recognised in the double cordon, the compulsory disinfection, and the slaughter of animals at the discretion of the authorities without their being put to the proof of "contact" of such animals with those that are known to have been affected with cattle-plague. The English law, on the other hand, enacts (Act, § 66) that "a local authority may, if they think fit, cause to be slaughtered any animal that has been in the same shed or stable, or in the same herd or flock, or in contact with any animal affected with cattle-plague within their district." Further, it is enacted (§ 69), that the compensation for the slaughter of animals under § 66, if the owner elects that the local authority shall dispose of the carcases, shall be "such sum, not exceeding thirty pounds, as may equal three-fourths of the value of the animal slaughtered." But if the animal slaughtered is itself affected with cattle-plague, or with a disease suspected to be cattle-plague, then (§ 68) the compensation shall be "such sum, not exceeding twenty pounds, and not exceeding one-half of the value of the animal immediately before it was affected with cattle-plague, as to the local authority seems fit."

The Act, therefore, imposes conditions which have a tendency to make farmers conceal cases of disease, in consequence of their inability to recover more than three-fourths of the value of the animal to the butcher (a mere trifle compared with the value of pedigree stock for breeding purposes). It also compels the ratepayers of affected districts who are not responsible for a disaster to pay for the negligence of those who ought to be so. For instance, the ratepayers of the East Riding of Yorkshire have recently had to pay for the negligence and bad arrangements of the authorities of Hull.* It therefore seems absolutely neces-

* *Vide* the description of the arrangements at Hull, p. 228.

sary that the law should be so altered as to place these matters on an equitable footing.

Dutch Ports.—Having described in detail the arrangements at Hamburg, it will not be necessary to do more than glance at a few differences in those which prevail at Rotterdam and Harlingen—the two principal ports of shipment in Holland. At all the Dutch markets and lairs the system of pens for cattle, with which we are familiar, is replaced by a system of posts and rails, the latter being furnished with rings at regular intervals. To these rings the beasts are tied by the head, and nothing can be more orderly and cleanly than the way in which everything is managed, from the railway to the market, thence to the dealers' lairs, and ultimately to the steamboat. The Dutch law is very strict as to inspection; and not only are the stock inspected on the market, but it is specially enacted that they must be examined, previous to shipment, in broad daylight by a Government inspector. I was also informed at Rotterdam that the shipping companies keep a veterinary surgeon in their employment to make an inspection on their own account. If it is considered for a moment that Holland is not a scheduled country, and that Dutch cows are in great request in England for dairy purposes, it will be admitted that these precautions are taken because it would not pay anybody concerned to send over diseased animals, which would probably condemn the whole cargo to immediate slaughter at the port of debarkation. It may also be mentioned that the Dutch fully appreciate the value of giving stock food and water previous to embarkation.

The Eastern English Ports.—The chief British ports engaged in the trade in foreign cattle are naturally on the eastern coast; but, as already stated, a small proportion of cattle are also imported into some of the southern and western ports. Table XI., on the following page, shows the number and kind of foreign animals landed at each port in 1871; and an examination of it seems to suggest the desirability of striking some of the less important off the list, and thus saving the expense of the inspectors who are, I presume, now appointed for the purpose of examining the few foreign animals which are landed there.

Hull.—This port has acquired an unenviable reputation in consequence of its having been the inlet of cattle-plague into Great Britain both in 1865 and 1872. It therefore seemed to me worth special inquiry whether any defect in the local arrangements might have been the cause of these invasions of the Rinderpest. Hull has the largest trade in foreign animals of any port on the north side of the Humber; and, with the exception of Harwich and London, the largest in the United Kingdom. In 1871 as many as 71,176 foreign animals were imported into Hull, nearly half of them being horned stock. The trade is chiefly with Hamburg, Bremen, Rotterdam, and Harlingen; but a certain number of cattle occasionally arrive from other ports. The now famous cargo of Russian cattle brought into Hull from Cronstadt in the 'Joseph Soames,' on July 25th, 1872, is an example. I was informed by a Hull merchant that this was an experiment to ascertain whether Russian cattle could be profitably imported; and it may be satisfactory (to agriculturists) to learn that, even if rinderpest had not been imported with these cattle, the venture would not have been profitable to those who made it.

TABLE XI.—A RETURN of the Ports at which Cattle, &c., have been Imported in the Year 1871, stating the Number Imported at each Port.

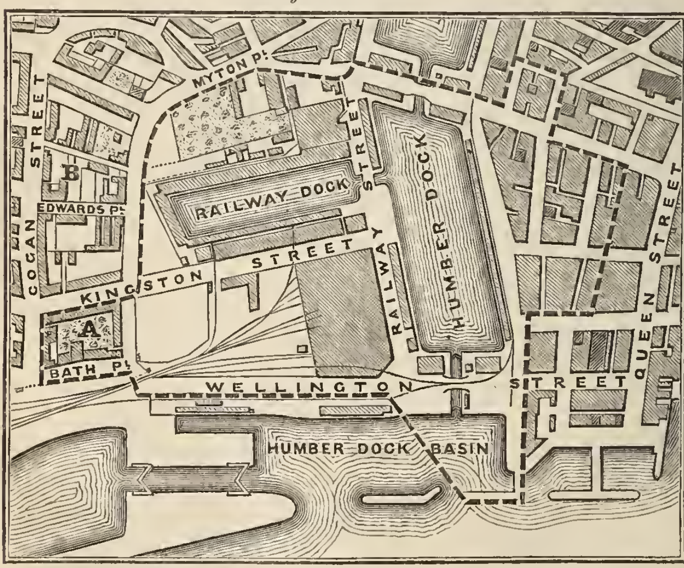
Ports at which Imported.	Live Stock Imported into the United Kingdom in the Year 1871.					
	Oxen and Bulls.	Cows.	Calves.	Sheep and Lambs.	Swine and Hogs.	Aggregate of all Kinds.
	Number.	Number.	Number.	Number.	Number.	Number.
London	75,326	22,370	23,443	590,840	31,863	743,842
Bristol	..	..	..	1	87	88
Cardiff	124	..	..	..	..	124
Dartmouth	..	..	..	..	2	2
Falmouth	3,168	..	..	..	..	3,168
Goole	54	452	47	1,396	161	2,110
Grimsby	79	1,425	326	11,512	10,818	24,160
Hartlepool	1,341	3,383	151	30,922	4,119	39,916
Harwich	2,880	11,635	10,936	141,354	19,827	186,632
Hull	7,872	21,860	4,800	30,719	5,925	71,176
Littlehampton ..	80	..	..	..	..	80
Liverpool	7,291	19	..	8,183	578	16,071
Middlesborough ..	206	2,013	249	9,524	903	12,895
Newcastle	5,042	5,802	69	39,783	6,090	56,786
Plymouth	6,778	218	1	17	..	7,014
Portsmouth	4,641	2	2	3	813	5,461
Shields, South ..	3	2	..	34	..	39
Shoreham	..	..	..	2	..	2
Southampton ..	13,131	4	..	59	885	14,079
Sunderland	7	..	..	38,877	3,060	41,944
Leith	5,624	3,985	75	12,682	386	22,752
Glasgow	340	..	..	..	24	364
Grangemouth ..	..	..	..	520	..	520
Granton	326	112	41	647	19	1,144
Kirkwall	24	57	..	1	..	82
Dublin	714	..	..	..	2	716
Cork	82	..	..	..	..	82
Total ..	135,133	73,339	40,139	917,076	85,562	1,251,249

S. SELDON.

Statistical Department, Custom House, London,
10*th April*, 1872.

Cattle from unscheduled countries are landed at a considerable distance from the boundaries of the defined part of the port, upon the "promenade" adjoining the Albert Dock, and are immediately taken to some well constructed and carefully kept sheds near the landing-place, where they remain until after inspection by the Government veterinary inspector. The Dock Company charge the consignees a small fee per head for receiving the cattle and taking charge of them during the period of quarantine. After inspection they can, if healthy, be sent into the country; and they are consequently sold either in the depôt or at the market in Edward's Place (see B, Fig. 1). It is to be wished that the arrangements relating to cattle from scheduled countries could be put on as satisfactory a footing as those just described. Such cattle are landed within the defined part of the port, generally either in the Humber Dock, or in the portion of the Humber Dock Basin within the limits of the defined part (see dotted line in Fig. 1). They are then driven to the depôt in Bath Place (A, Fig. 1), where they are inspected, and sold for slaughter within the limits of the defined part. An inspection of the plan will show that the ordinary cattle-market in Edward's

Fig. 1.—*Plan of the "defined part" of the Port of Hull and the adjacent streets.*



A. Depôt and Quarantine Station for Foreign Cattle from Scheduled countries.
B. Market for English and Unscheduled Foreign Cattle.
The dotted line shows the limits of the "defined part" of the port.

Place (B, Fig. 1) is dangerously near the landing-places and the cattle-depôt within the defined part of the port; and, in fact, to the defined part itself as a whole. Besides the danger arising from cattle rushing up a wrong turning, and so into the midst of a lot of English beasts, there is the greater danger arising from the drovers and dealers themselves going direct from a lot of foreign animals into the English cattle-market, not much more than 100 yards off. Many people are of opinion that in this way the cattle-plague virus was taken direct from the 'Joseph Soames' into the market in Edward's Place. It will be remembered that there were altogether eight importations of cattle affected with Rinderpest,* namely, two each into Deptford, Hartlepool, and Newcastle, and one each into Leith and Hull. Shortly afterwards cattle-plague broke out in the East Riding of Yorkshire; and this result was attributed by some to the cause already indicated, and by others to the washing on shore of the diseased carcases, which had been apparently sunk in a lighter, by order of the Government inspectors. Probably the Report of the Veterinary Department for last year will eventually clear up this matter;† but in the meantime it may be observed that Professor Simonds has stated ‡ that, so far as the investigation had then gone [August, 1872], the outbreak of cattle-plague "in no way depended on the washing ashore of the carcases of the animals which ought to have been sunk off the mouth of the Humber." Should this inference be confirmed, the Privy Council should, in the public interest, either extend the limits of the defined part of the port, so as to include the existing cattle-market within them, or they should remove the "defined part" to a distant part of the port, or they should remove Hull from the list of ports at which animals from scheduled countries could be landed. If the first step were taken, the Corporation of Hull would be compelled to provide a new cattle-market, available sites for which (such as Fair Field) are not wanting in suitable situations; but at present it is not too much to say that the limits and position of the defined part of the port are regulated by the situation of private slaughter-houses, without regard to the dangerous proximity of the ordinary cattle-market.

Harwich.—This port is little more than a resting-place and

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* See 'Journal of the Royal Agricultural Society,' 2nd series, vol. viii., part 2, No. 16, pp. 367-373.

† In order to do this satisfactorily, the Report should describe the manner in which the provisions of the last paragraph of Section 61 of the Contagious Diseases (Animals) Act (relating to the disinfection of persons having come in contact with animals affected with cattle-plague) were carried out by the Hull authorities on the persons of the veterinary inspectors, police, sailors, drovers, and others who came in contact with the plague-stricken animals (or their excreta) forming part of the cargo of the 'Joseph Soames.'

‡ *Loc. cit.*, p. 373.

quarantine station, and the arrangements there are very much like those at Holyhead and New Milford. There is, however, a remarkable difference in the manner in which the cattle are landed; for the Harwich boats are discharged by gangs of sailors (I believe the crews of the vessels), each man leading a beast by its head-rope, and in due time returning for another. The cattle-trade of Harwich is confined to that with unscheduled countries, and is practically restricted to Holland and Belgium, whenever the trade with those countries is unfettered. There is, therefore, no defined part of the port, and the whole of the animals landed may pass into the country if, after at least twelve hours' quarantine, they are certified by the Government inspector to be free from any contagious or infectious disease.

In 1871 the importations into Harwich amounted to 2880 oxen and bulls, 11,635 cows, 10,936 calves, 141,354 sheep and lambs, and 19,827 swine, making a total of 186,632 animals. Out of this large number, only 11 pigs from Antwerp and 4 sheep from Rotterdam were found affected with disease, namely, foot-and-mouth. This fact, so far from being universally regarded as satisfactory, is by some considered evidence that the diseased condition of many other animals has been passed undetected. It may, therefore, be useful to quote the following official statement from the Report of the Veterinary Department for 1871 (pp. 8 and 9):—

"During the year 1871 no case of foot-and-mouth disease or pleuro-pneumonia occurred in the parishes of either Harwich or Dovercourt. These parishes contain an area of upwards of 3000 acres, within which area are many farms and dairies. At Harwich more Dutch cattle have been landed since the restrictions were removed than at any other port in Great Britain, except London. The cow-keepers at Harwich and Dovercourt are in the habit of filling up any vacancies in their dairies with Dutch cows, and there is scarcely a farmer in Dovercourt parish who has not taken Dutch cattle in to keep. Notwithstanding this, these parishes enjoy an exceptional freedom from contagious or infectious diseases amongst their stock."

This statement is corroborated by the following extract from a letter written by a resident in the neighbourhood, well qualified to form an opinion on the subject, were it necessary. The following, however, is merely a statement of fact:—

"There has been a market held at Harwich every Friday since last May (1871) for the sale of foreign store cattle and milch cows; these arrive on the Sunday, Tuesday, and Thursday; after undergoing the twelve hours' quarantine, if free from disease, they are delivered to their owners, who turn them out to graze on the pastures in Harwich and Dovercourt till the market day. I have seen them grazing with nothing but a fence separating them from the home-bred cattle; and it will surprise you when I tell you that neither of these two parishes has had a case of pleuro-pneumonia or foot-and-mouth disease within them. If foot-and-mouth disease is all imported, will any one tell me why Harwich and Dovercourt are free when there have been more foreign cattle driven through and kept in them than any parish I know? The number of animals which arrived at Harwich in July was a little over 28,000 —I think this is about the average number—from 4000 to 5000 of these were cattle, the remainder sheep and pigs; three-fourths of the cattle were store and milch cows. A great number of Dutch cattle are grazing in the Tendring Hundred district. I have never seen one have the foot-and-mouth when they have been taken direct from Harwich."

London.—Considering that more than half of the total number of foreign animals imported into the United Kingdom come direct to London, it may be expected that the arrangements at the different wharves and landing-places would be described in this Report in considerable detail. It will be sufficient, however, to state the facts very briefly. Animals from scheduled countries must be landed at the new Foreign Cattle Market at Deptford—an immense series of lairs and slaughter-houses, which are walled in on every side except the river, where they are approached by three well-appointed landing-stages, at which cattle can be unshipped at any state of the tide. The arrangements are so nearly perfect that they deserve careful description and illustration on account of their intrinsic merit; but it is enough for the purpose of this Report to state that they are admirably adapted for the prevention of the conveyance of germs of disease beyond the walls of the market itself—that is to say, beyond the boundary of the defined part of the port of London. The wharves for the reception of cattle from unscheduled countries present no special feature that requires detailed description. They are situated on the opposite side of the river from Deptford, and may be regarded as merely resting-places and quarantine stations between the steamboats and the Metropolitan Cattle Market at Islington.

IV.—Steamboats Engaged in the Cattle Trade.

The arrangements of the steamboats engaged in carrying cattle are in principle the same in the Irish trade as in the Foreign. There are differences in detail, but otherwise a description of any ordinary steamboat will give a fair idea of the others.

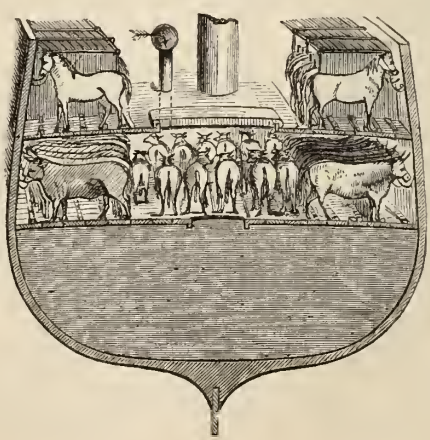
Commencing with the embarkation of the cattle, it may be stated that in Ireland they are always driven, and in Holland generally led, on board. The cruelty often practised by drovers during this operation is quite unnecessary, and has, if I am not mistaken, led to a series of investigations and reports to the Irish Government. It is, however, extremely difficult for a known official to see, and much more to describe, the actual course of events under ordinary circumstances. For this reason I believe that the deterrent influence of an energetic officer of the Royal Society for the Prevention of Cruelty to Animals is very great, provided that the police authorities understand that his activity does not relieve them from responsibility.

The practice of slinging is not now resorted to except in cases of necessity. The usual plan is to drive the beasts to the gangway-plank, and so to arrange their subsequent route that they have no choice but to reach their proper destination. This they do, generally half blinded with pain and deafened with noise, and are then secured by a head-rope in the position which they have to occupy throughout the passage.

Why the head-rope should not be put on in the receiving-yard of the forwarding company, and the animal led on board, as in Holland, I cannot understand. It would, in my opinion, take no more men and would occupy less time than the present system.

The following section of a cattle steamboat will illustrate the manner in which cattle are stowed. The number of holds, the number of rows of pens (both of which are reduced to a minimum in the sketch, for the sake of simplicity), and other matters of detail, will, of course, vary with the nature of the traffic and the size of the steamboat. Some have as few holds as those shown in the figure, while others have as many as three cattle-holds, and carry animals on the poop or bridge as well as on the main deck.

Fig. 2.—*Transverse Section, illustrating the Ventilation and Stowage of the Cattle-hold of a Steamboat.*



Although live stock are carried on deck as well as in the holds, the owners much prefer the former method. The deck, however, is usually reserved for horses, so far as the space is required; and in the event of room being still available, the preference is generally given to sheep and pigs, except when a very large or very liberal consignor secures it for his beasts. It is important to understand that it is a great advantage to secure deck-places for cattle, because this knowledge enables one to appreciate the conditions which require amendment in the sea-conveyance of live stock. The officer of the watch on one of the steamers plying between Drogheda and Liverpool—a passage of about twelve hours—told me that the cattle on deck would fetch in the market at least 1*l.* per head more than they would have done if they had been in the hold, whereas the charge for conveyance was less than half this sum. On this occasion there were not a large number of cattle in the hold, but they raised the temperature from 70°, at which my registering thermometer stood on deck, to 80° in the hold near the hatchway. Several observations of the temperature of the holds of cattle-boats gave about the same result, the index never falling below 79°, nor rising much above 80°.

The mode in which the ventilation of the hold is usually performed will be understood by reference to the longitudinal section of an ideal steamboat (Fig. 3, p. 234), in which the ordinary metal "ventilators" or "windsails" are alone used for the purpose.

This diagram indicates the fact that mere "openings" do not necessarily produce currents of fresh air, but that the proper removal of vitiated air from the holds, and its renewal by fresh air through the agency of the windsails, depend upon the concurrence of several favourable conditions. First of all, it is necessary that the mouth of the ventilator should be kept in a position to receive the wind, and thus make its shaft a more or less powerful "down-cast" or supply-pipe of fresh air. If this is not done carefully, it is obvious that the supply of fresh air to the hold must very soon be practically stopped. The same result must follow during the time that the steamboat is at anchor or moored to a wharf, or when there is little or no wind. This not unfrequently happens in the case of the Cork steamers, which have to wait for the tide at Passage from one to four or five hours. It is also the case when the steamer is slowly feeling its way up a tortuous river, such as the Avon from Kingroad to Bristol; for, however attentive the crew may be, their other duties do not allow them time to shift the ventilator with every change in the course of the steamboat along a winding stream.

In the second place, the amount of air conveyed into the hold by these ventilators is dependent upon the relation existing

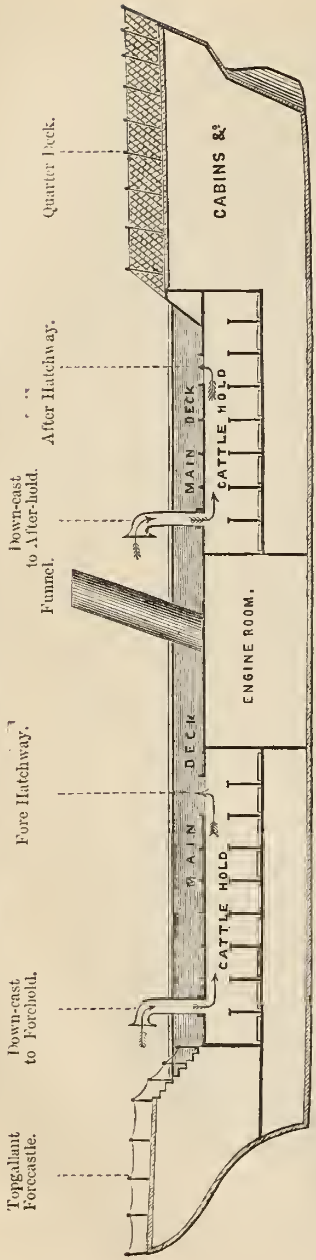


Fig. 3.—*Longitudinal Section, illustrating the Ventilation of the Cattle-hold of a Steamboat.*

between the direction of the wind and the course of the steamboat. If the wind is, for instance, ahead of the steamboat, its ventilating force is increased by the accelerated velocity due to the speed of the vessel, say 10 miles an hour. If, on the contrary, the wind is abaft the steamboat, its ventilating force is diminished to even a greater extent, because the steamboat will be then making more way. However, it may be reckoned that the ventilating force of wind (of a given velocity) on the hold of a cattle-steamer varies to the extent of that due to a current of air travelling at the rate of 20 miles per hour.

The influence of the direction of the wind on the ventilation of the hold is not confined to the circumstance just stated. It is well understood that proper ventilation cannot be obtained without an outlet for the noxious gases, as well as an inlet for the fresh air. The ventilation of the hold of a ship is therefore as dependent upon a proper outlet or "upcast" as a proper inlet or "downcast." The upcast is almost always obtained by leaving the hatchways open (see Fig. 3), and not unfrequently this opening is made to do double duty by having a canvas windsail put down the centre of it. Of course, if the wind is abaft the steamer, it assists in blowing away the vitiated and heated air that seeks to ascend, partly in consequence of the action of the downcast, but chiefly in obedience to the force of gravity. If, however, the wind is ahead, it tends to drive the exhausted air back into the hold, and further acts as a shut valve to prevent its escape.* Similarly, the downcast air has to overcome the resistance of a column of heated air which is naturally ascending, and, as it were, trying to escape through the tube of the windsail.

These defects, however, can be easily controlled by mechanical means; and as it does not appear that contrivances for this purpose are generally known, I have thought it advisable to give a section of a metal windsail or ventilator, furnished with an upcast as well as a downcast arrangement, so as to remove the last-mentioned obstruction to the column of fresh air; and also of one of the machines known as blast ventilators, which are worked by a small steam-pipe from the ship's boiler.

The first of these arrangements does not require any further explanation; and of the second, it will be sufficient to state that the steam from the boiler entering the small steam-pipe shown in Fig. 5, and impinging against a wheel having transverse projecting ridges on its circumference, drives it round as water does an ordinary water-wheel. The shaft from this wheel is connected with a fan (shown in the upper part of the figure) which drives fresh air into the hold, acting like the blower of a winnowing machine. The manufacturers (the Co-operative Ironworks Company, Northmoor Foundry, Oldham †) have informed me that such an apparatus, capable of injecting 350 cubic feet of air per minute, costs only 15*l.* 10*s.* Larger sizes cost more money, but are nevertheless relatively cheaper, in comparison with their power, so that a machine capable of pumping into the hold 4500 cubic feet of air per minute does not cost more than 55*l.* 10*s.* Under these circumstances, it appears to me that all cattle-boats should be furnished with machine ventilators of such a power that the ventilation of their holds should be both adequate and uniform, without being dependent on variations in the force and direction of the wind, the state of the tide, or the speed of the steamboat.

That there is no practical difficulty in the way of ventilating the cattle-holds by mechanical means is sufficiently proved by the fact that some of the steamboats belonging to the City of Dublin Steamboat Company and the North German Lloyd are

* Mr. Walters has also noticed this fact in the 'Food Journal,' vol. iii. p. 469. That gentleman, however, seems to infer that the lower holds are the worst ventilated; but a consideration of the various circumstances affecting the ventilation of steamboats ought to be sufficient to show, on the contrary, that, in a steamboat having several cattle-holds, the best ventilated one is, *cæteris paribus*, the lowest, because there is the greatest difference in the relative weights of the upcast and downcast columns of air having access to it.

† Machines for, I believe, drawing off foul air are manufactured by the Union Engineering Company, 2, Clarence Buildings, Booth Street, Manchester; but I have not received a section of one in time for publication.

Fig. 4.—*Section of Harness' Patent Air-circulating Ventilator.*

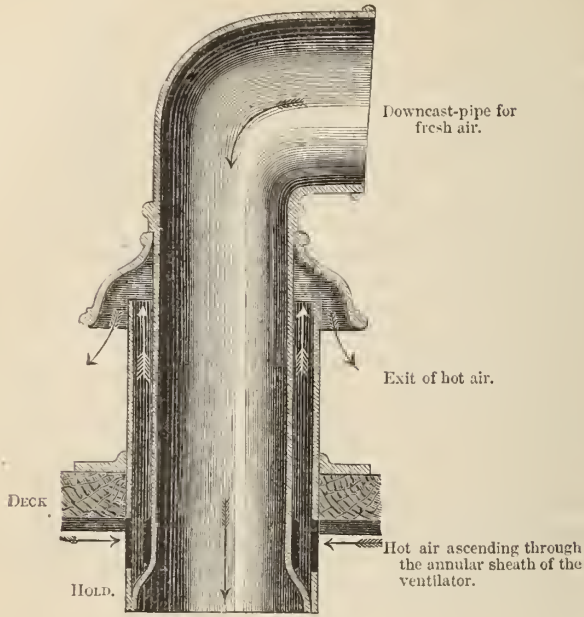
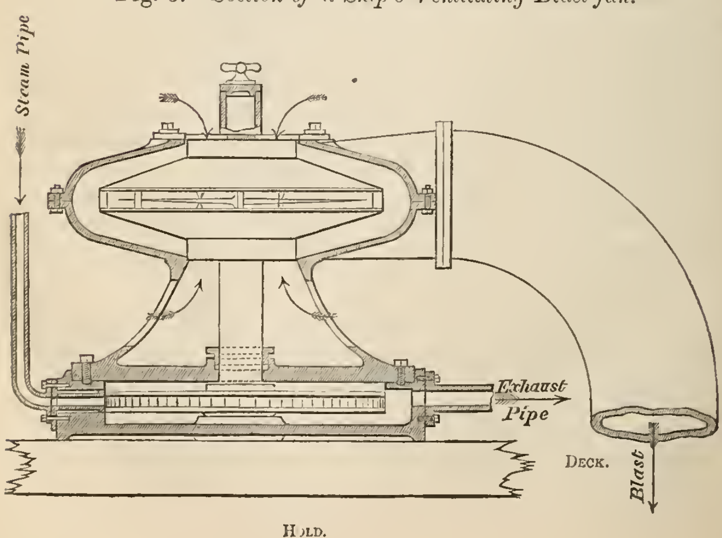


Fig. 5.—*Section of a Ship's Ventilating Blast-fan.*



already fitted with blast-ventilators. I never had the good fortune to secure a passage on board one of these boats, but I witnessed the unloading of a cargo of Bremen cattle at Hull from a steamboat thus fitted belonging to the latter company, and was so struck with their cool and fresh appearance that I examined the vessel. The good condition of the cattle was, doubtless, due to the action of the machine ventilator, as I could find no other distinctive feature in the steamboat. These cattle presented to my mind a great contrast with those usually landed at Bristol and Liverpool, which have the steaming coat and the tottering gait characteristic of a cargo of Irish beasts after a voyage of less than half the length of that from Bremen to Hull.

The passage from Bremen, or Hamburg, to Hull, is said to occupy thirty-six hours, and in fair weather it may be done in that time; but I have been three nights and two days in a cattle boat from Hamburg to Hull, and occasionally the passage takes even longer. It is obvious that if cattle are to be landed in even tolerable, not to say superior, condition after a sea voyage of that duration, they must be supplied with a fair quantity of fresh air as well as food, and must be allowed sufficient room to lie down. The practice of different companies varies somewhat in detail, but the principle is the same. On the steamer in which I travelled from Hamburg the fore-hold was reserved for cattle; there was no machine-ventilator, but there were two downcast windsails forward, and two upcasts abaft the hatchway, which was also used for ventilating purposes. The floor of the hold had a thick layer of sand, partly for ballast, and partly to soak up the liquid excretions. The beasts were allowed sufficient room to lie down, and were fed twice a day by the crew, who received 8*d.* per head of cattle, divided between them, for performing this duty. I was informed that cattle will rarely eat the first day that they are at sea, but that afterwards they eat very well, though they drink little or nothing. After discharging the cattle, the sand and manure are taken out, the hold is washed with water, and then strewed with chloride of lime. The Harlingen merchants prefer to send their own drovers to feed and look after their cattle, and they use sawdust instead of sand for litter.

So far as I have been able to observe, it has seemed that the longer the average duration of the passage, the better the cattle are cared for, and the better do they appear when landed. This fact was forcibly illustrated at Harwich on one occasion when I had travelled from Rotterdam with a very full boat-load of cattle, sheep, and dead meat. The average length of the journey is from 12 to 14 hours, but, on this occasion, an adverse gale of wind had extended it to 28, of which 17 were spent at sea between Hellevoetsluys and Harwich. The beasts were packed as tightly as in the Irish trade, and they came out of the hold in the same steaming condition; while the sheep, which had been packed on the bridge, were doubtless suffering from the other extreme of temperature. Between Rotterdam and Harwich the cattle are not fed and watered, as the shortness of the average passage renders it unnecessary; and the difference in the condition of the beasts when landed seemed to me entirely due to overcrowding and consequent insufficient ventilation.

The steamboats engaged in the Irish traffic are, for the most part, managed in the same manner as the Harwich boats. Sawdust is used as litter, the beasts are packed as closely as possible, and the ventilation is generally more or less insufficient. These conditions produce a very foul atmosphere, containing a large quantity of moisture exhaled from the bodies of the animals, and a remarkable quantity of ammonia, sulphuretted hydrogen, and other disagreeable gases. As a consequence it is almost impossible for a man not accustomed to the duty to remain in the hold even for a minute, the effect upon his eyes being far worse than that of the reddest London fog. The ammoniacal gases also irritate the nose and the throat, while the exhalations from the solid excreta are far more potent than what would generally be considered sufficient to induce, if not to generate, fever in human habitations. The effect of such conditions upon an animal that has fasted for two or three days seems to me too obvious to require explanation.

The temperature is not so high as might perhaps be anticipated. Blood-heat is 98° Fahr., and the temperature of the hottest part of the body of even a diseased animal does not often rise to more than 105°. The comparatively low average temperature of 80° which prevails in the hold of a cattle-boat is, therefore, easily explained by the fact that the large quantity of moisture continually being generated in the hold, and passed through its atmosphere, absorbs, and retains latent, a vast quantity of heat to keep it in the state of steam.

The extent of the evaporation of moisture from the bodies of animals closely packed in a steamboat can scarcely be realised by those who have not witnessed the landing of a large cargo of Irish beasts. Mr. Walters * has mentioned the fact that when the importations from Ireland *viâ* Bristol consisted chiefly of pigs, one who saw the vessels arrive "needed nothing but one's *nose* to know what they had for a cargo." At the present day the landing of a large cargo of beasts is not unfrequently made known to people at a short distance by the mist they create, in consequence of the exhalation of steam from their bodies.

* 'Food Journal,' vol. iv., No. 37, February 1873, p. 17.

The condition of animals on landing must be regarded as an index of the state of the place they have left; therefore, the question of the proper cleansing of the holds of cattle-ships appears one of paramount importance. It seems impossible to conceive any circumstances more favourable to the development of germs of disease than those existing in the hold of a steamboat, just as seeds of plants will germinate more quickly in a greenhouse than under ordinary atmospheric influences. It is, therefore, most essential that such places should be thoroughly cleansed and disinfected, under the superintendence of the Government Inspector, before the vessels are allowed to take a return cargo. It is useless to trust to such a process of cleansing as will enable a return cargo to be taken, for the germs of disease have a vitality sufficient to outlive several short passages, if not destroyed by direct means. I should, therefore, recommend that no steamboat or other vessel shall be allowed by the Veterinary Inspector at the port of embarkation to receive animals until after the master or owner has delivered a certificate, signed by the Veterinary Inspector at the last port of debarkation, certifying that such steamboat or other vessel has been properly cleansed and disinfected since the last landing of animals therefrom.

I am aware that some of the steamboats engaged in the Continental trade return in ballast, and that their cleansing and disinfection is said to be done during the return voyage. In these cases it will be urged that such a rule as that just recommended would involve the loss of a tide, and that this would add such a price to the cost of transit of the cattle as to amount to a prohibitive duty. To meet such objections it would be easy to make an alternative rule that animals imported in vessels not complying with the foregoing stipulation should be treated as coming from a scheduled country, that is to say, that such animals should be slaughtered at the port of landing.

Before concluding this part of the subject I must mention what may, perhaps, be considered a trivial matter. But the mode of disposal of the mixture of manure and sand, or manure and sawdust, from steamboats, and that of the manure from receiving yards, is really by no means unimportant. Generally it is sold at intervals, either more or less disinfected by mixture with quicklime or otherwise; but the London and North-Western Railway Company prefer to avoid all risk by placing it on the "spondons" (the projecting ridges of the paddle-boxes) of their steamboats, and shovelling it overboard when they get into the "Race" or most rapid part of St. George's Channel. Whatever system is adopted the disposal of these refuse substances should be under such regulations as are calculated to prevent their becoming a vehicle for the conveyance of contagion.

V.—Conclusion.

During the progress of the investigation, the results of which have been described in the preceeding pages, I was careful to note the bearing of the facts upon the suggestions which the Society might make to the Government, with a view to the improvement of the existing regulations, by rendering them better calculated to prevent the spread of disease. It requires considerable care, however, to avoid a judgment biassed unduly in favour of any one interest to the injury of the remainder. For instance, the proposal to subject all animals imported from Ireland to a quarantine of ten days would, no doubt, if properly carried out, give farmers who buy Irish store cattle a great amount of security against the purchase of disease. But the importations from Ireland average considerably more than 1000 beasts per diem, divided for the most part between four or five ports; and at each port accommodation would be required for ten days' importation (say between 2000 and 3000 beasts, besides sheep and pigs). To serve the purpose of the quarantine, each day's importation would have to be absolutely separated from every other day's importation, and the pen for each animal would have to be capable of complete isolation from that of every other. The practical difficulty and expense of providing the necessary accommodation would, therefore, be enormous, the whole falling upon the farmer in the first instance, but ultimately taking the shape of a tax upon the consumer.

It is not my intention to discuss further this or any other proposed remedy. The mere statement of the one quoted is sufficient to illustrate the difficulty of having due regard to the claims of conflicting interests, viz., the British and the foreign producers, the dealers, and the consumers. Solutions on the principle of cutting the Gordian knot are, in my view, altogether inadmissible; and I, therefore, carefully studied the question of inspection with a view to test its efficacy, when conducted under proper regulations. The conclusion at which I arrived was that inspection at the ports of both the exporting and the importing country, as at Rotterdam and Harwich, with proper control of the persons engaged in the trade, proper supervision of their premises, proper inspection of the steamboats, cattle-trucks, and receiving-yards, and due regard to the most elementary principles of hygiene, would go a very long way towards bringing the danger of importing foot-and-mouth disease under control.

It is, however, equally necessary to exercise strict supervision over the inland trade, and over what may be termed the domestic movement of stock, by making proper regulations with regard to fairs and markets, the provision of slaughter-houses, and other matters now left optional with the local authorities. And in all cases it is most desirable that uniform action should be secured throughout the country.

Accordingly, my original report to the Council of the Society last November (being an abstract of the facts contained in the preceding pages) was accompanied by a draft of a series of suggestions based on the principles just stated. Some of these suggestions could not, at present, be carried out at all places to which they were made applicable, especially in Ireland; but it seemed to me that if the places that could not comply with the regulations were therefore abandoned as centres of the cattle-trade, the public benefit would be enormous. For instance, what possible good can result from the holding of 6000 fairs per annum in Ireland alone? If only one-half of them were abandoned in consequence of the compulsion to divide the fair-green into pens, which should be cleansed and disinfected, the only persons who would suffer would be the local publicans, and the benefit to the rest of the community would be very great. The same argument holds good for the rest of the United Kingdom, but it has not, probably, the same force everywhere.

The registration of sales of stock at fairs and markets is also another point that would be difficult to carry out in all localities under existing circumstances; but, in my judgment, a mart that is too insignificant to sustain the expense of such an arrangement ought not to be held at all. The probability is that if such a system had been in operation at Hull when the 'Joseph Soames' arrived, the whereabouts of every animal still living, that had been in the tainted market, would have been at once ascertained; and if the authorities had been energetic enough, and the law would have permitted the procedure, the whole of them would have been "sides of beef" in less than a week.

The difficulty of securing trustworthy inspectors has been frequently quoted as insuperable, and doubtless a coin of the realm is an exceedingly bad eyeglass. But if the Inspectors were properly paid, and were compelled to make returns of each cargo and each market to the local authority and the Government, stating not only the number of diseased animals in each, the names of the owners, and the nature of the disease, but also indicating the stage which the disease had reached, such returns, in the case of ports, from the Inspector in Ireland would be a check upon the returns made by the Inspector at the English port, and *vice versâ*, and thus the inspection would be rendered efficient.

As a matter of fact, however, I am not aware that complaints against the manner in which the Veterinary Inspectors in England discharge their duty have been often preferred, and I am not conversant with a single case in which any accusation has been substantiated. There is probably more uncertainty felt as to the action of the Continental Inspectors, and less reliance placed on their skill. For instance, it is not unfrequently stated that measures are taken to get animals from a scheduled country passed into England as if they had come from an unscheduled country; thus German sheep are stated to be shipped at Hamburg for Antwerp, and sent from Antwerp to England as Belgian. Such an oversight on the part of the Inspector as would allow any clear cases of attempted fraud to pass unrecognised at the Continental or the English port, if promptly dealt with by the Home authorities, would probably not recur very soon.

With regard to inspection in Ireland, all that can be said is that, so far as I know, it has never been systematically tried, and, therefore, its chances of success or failure are entirely unknown.

The supervision which I have recommended as supplementary to inspection has for its object the *prevention of contact* between diseased and healthy animals, and the vigorous destruction of disease-germs as soon as possible after they are formed. By some such means, properly carried out, I believe that we should obtain results as good as by such sweeping measures as the slaughter of all imported animals at the port of landing, while we should still retain the much-needed Dutch cows and Irish stores, and not interfere in any appreciable manner with cattle-dealers who are too scrupulous to enrich themselves to the extent of a penny by inflicting an injury on the public to the extent of a pound.

The Council of the Society having received the Abstract of this Report, as already stated, referred it to the Cattle Plague Committee, consisting of the whole Council. After an interval of a month it was carefully considered, both by the Committee and the Council, and finally the following suggestions were, last December, made to the Government in reply to the invitation of the Vice-President of the Privy Council given the previous July:—

(1.) That a sufficient number of Veterinary Inspectors be appointed by the Government at the ports, both in England and Ireland, to examine properly every animal previous to shipment or landing, as the case may be (pp. 198, 211, &c.)

(2.) That a return of the animals found affected with any contagious or infectious disease, with the names of their owners and the nature of the disease, shall be furnished, at such intervals as may be deemed desirable, by the Government Inspectors at the ports to the Veterinary Departments in London and Dublin respectively, and in England to the local authority (p. 241).

(3.) That the prosecution of the owners of animals so reported as diseased shall in England be undertaken by the local authority, and in Ireland by the Veterinary Department of the Privy Council.

(4.) That the regulations as to right of entry, liberty to inspect, and evidence of the existence of disease (the Inspector's certificate), which are now applicable to cases, or suspected cases, of pleuro-pneumonia, shall be extended to foot-and-mouth disease (Act, sec. 31–33) (pp. 197 and 199).

(5.) That all lairs or yards belonging to Railway and Steamboat Companies, and all market places and places set apart for the holding of fairs for cattle, sheep, and pigs, shall be divided into pens of a convenient size, and furnished with a sufficient number of troughs of clean water; and that these pens shall be cleansed and disinfected in accordance with the existing regulations of the English Privy Council in reference to railway pens and landing places (pp. 212 and 241).

(6.) That the cleansing and disinfection of the steamboats and other vessels used for the carriage of animals shall be rigorously enforced; and that no steamboat or other vessel shall be allowed by the Government Veterinary Inspector at the port of embarkation to receive animals until after the master or owner has produced and delivered a certificate signed by the Government Veterinary Inspector at the last port of debarkation, certifying that such steamboat or other vessel has been properly cleansed and disinfected since the last landing of animals therefrom (p. 239).

(7.) That the Railway Companies in Ireland as well as in England shall be compelled to cleanse and disinfect their railway trucks and sidings, in accordance with the existing regulations (p. 202).

(8.) That food and water in ordinary quantities be supplied to all animals either before or after inspection, both at the ports of shipment and landing, whether requested by the persons in charge or otherwise (pp. 210, 211).

(9.) That animals exposed for sale at fairs and in markets, both in England and Ireland, shall in all cases be inspected by duly qualified Veterinary Surgeons, or Inspectors appointed by the Local Authority, and that it is essential that offenders against the law shall be adequately punished on conviction (pp. 204-209).

(10.) That the provisions of the Privy Council (Ireland) Order * of November 4th, 1870, be modified so as to conform to the provisions of sec. 57 of the Contagious Diseases (Animals) Act,

* Sections 3 and 13.

with reference to contagious or infectious diseases other than glanders, cattle-plague, or sheep-pox (p. 207).

(11.) That the neglect to conform to any of the provisions of the Act, or of the Orders in Council founded thereon, shall henceforth be punished as an offence against the Act; and that the penalty clauses shall henceforth include a minimum as well as a maximum fine (p. 202).

(12.) That all cattle-dealers shall be required to take out a licence, which licence shall be granted or refused by the magistrates of the district in which the applicant usually resides; and that the said licence shall be suspended or revoked at the discretion of the magistrates in the event of the dealer being convicted more than once of wilful non-compliance with the regulations of the Privy Council, or of the local authorities (pp. 217, 218).

(13.) That a register be kept in each district of the cattle-dealers licensed therein.

(14.) That the lairs, yards, fields, and other premises used for the temporary reception of animals, whether inland or at the ports of landing and shipment, be duly certificated for the purpose, and registered (p. 216).

(15.) That in order to prevent cruelty, sheep and cattle should never be carried together in the same truck.

(16.) That in order to secure proper cleansing and ventilation of the holds of steamboats, all vessels employed in carrying animals shall be certificated; and that no certificate shall be given to any steamboat or other vessel not now engaged in the trade, unless the ventilation of the holds intended for the reception of animals be performed by means of properly constructed machine-ventilators (pp. 233-239).

(17.) That the Privy Council should from time to time send down their own Inspectors to the markets, in order to see that the regulations are properly carried out, and that the inspector should institute proceedings against persons whom he may detect offending against the law (p. 219).

(18.) That at the ports licensed for the importation of foreign animals the local authorities shall provide slaughter-houses contiguous to the ordinary cattle-market, also to the landing-stage for cattle from unscheduled countries, and within the defined part of the port, for the landing and slaughter of animals from scheduled countries (where such exist) within the boundaries of their jurisdictions, as is the case at Deptford (pp. 217, 229).

(19.) That in all cases the landing-places for cattle from scheduled and unscheduled countries should be decidedly apart, and that the markets for cattle from scheduled countries should in all cases be separated by some considerable interval from the ordinary market (p. 228).

(20.) That to enable the local authorities to trace the dispersion of a contagious or infectious disease, such as cattle-plague or sheep-pox, from a fair or market, the name and address of the person owning the cattle or sheep at the time of departure shall be registered by the clerk of the fair or market (pp. 225, 241).

(21.) That with reference to cattle-plague, it is desirable to add to § 53 of the Contagious Diseases (Animals) Act, as follows:—Where, under the Act, a place is declared to be an infected place, either by the order of the Privy Council, or of the local authority, or by the declaration of an Inspector, a return of the cattle, sheep, and other animals (including horses) within the infected place, shall immediately be made to the clerk of the local authority by every owner of such cattle, sheep, or other animals; and in the event of any of the said animals becoming affected with any disease whatever, the same shall be immediately reported to the police by the owner of such animals. Upon such report being made to the police, the local authority shall cause the Veterinary Inspector to examine the animals affected and certify in writing as to the nature of the disease (p. 225).

(22.) That it is most desirable that in any legislation on the subject of cattle diseases, uniform action should as far as possible be generally enforced (pp. 195-197).

(23.) That in cases of cattle-plague, the Veterinary Inspector of the Privy Council shall be empowered to order the slaughter of animals in adjacent fields to those actually infected, as well as the animals in the same field, cowshed, &c., in the event of such a course being considered necessary to prevent the spread of the plague (p. 225).

(24.) That the prohibition of the importation of cattle from Russia should continue as long as cattle-plague exists in that country; and that any country permitting the importation of Russian cattle during that period should *ipso facto* become a scheduled country.

In addition to the foregoing suggestions, they beg leave to add the following, which, if adopted, would render compulsory the action of the local authorities in certain matters which, according to the provisions of the existing Contagious Diseases (Animals) Act are optional with them:—

Act, § 41 *alter* may *to* shall.

§ 53 *alter* may *to* shall, *and omit* "if the circumstances of the case appear to him so to require."

§ 57 *after* coasting vessel *insert* "or a vessel engaged in the cross-channel trade."

§ 57 *after* execution of this Act *for* may *read* shall.

§ 66 *for* may, if they think fit, *read* shall.

§ 86 first line, *for* may *read* shall; fourth line, *for* infectious disease, or, *read* infectious disease, and

VI.—*Further Report by the Judges on the Competition for Prizes for Plans of Labourers' Cottages in connection with the Cardiff Meeting*, 1872.

In the Report, published in the last number of the 'Journal,' on the Plans shown at Cardiff in competition for Prizes offered by the Marquess of Bute and Major Picton Turbervill, the Judges remarked:—"Although there was no set of Plans which they could recommend, as a whole, worthy of a prize, there was one (marked 'Rustic,' No. 40, entered by Mr. Hine, foreman at the Patent Brick Works, Worcester) which, in its arrangements both of living and bed rooms, possessed a simplicity, originality, and convenience which may be worked into something very useful;" and they recommended that, with the sanction of the designer, this Plan should be published in the Society's Journal, leaving out his elevations.

This recommendation having been approved by the Council, the Judges have great pleasure in publishing the Plans, and in submitting two designs showing elevations adapted to them (Plates I. and II.).

Figs. 1 and 2.—*Mr. Hine's original Plans, exhibited at Cardiff, marked 'Rustic,'* No. 40.

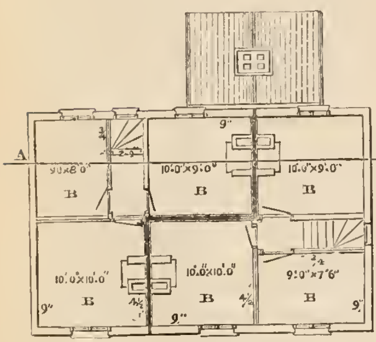


Fig. 1.—Chamber Plan.
B B. Bedrooms.

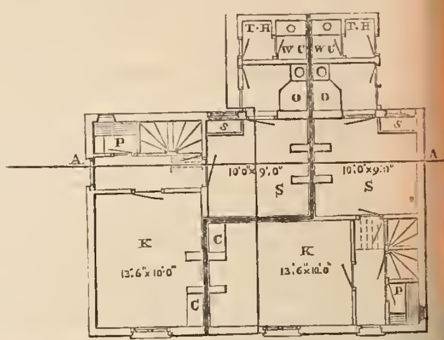


Fig. 2.—Ground Plan.
K K. Kitchens. O O. Ovens.
S S. Sculleries. P P. Pantries.
s s. Sinks. C C. Cupboards.
T. H. Tool-house.

The ground-plan, it will be observed, is an oblong (not considering the out-offices), roofed by a single span, and being without a single break of any kind. Such an arrangement is obviously cheaper than one having breaks, valleys, and gutters.

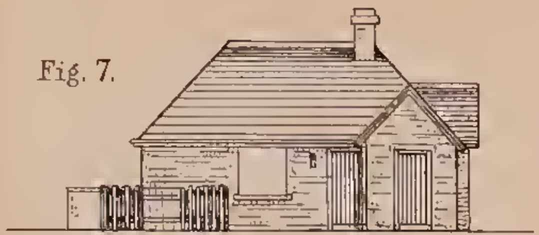
The accommodation on ground and chamber floors embraces all that is really necessary. On the ground-floor are a living-room and scullery, both sufficiently large, and a small pantry, well venti-

PLANS AND ELEVATIONS FOR LABOURERS' COTTAGES, IMPROVED BY THE JUDGES FROM THOSE EXHIBITED AT CARDIFF BY "RUSTIC."

Figs 7. 8. 9.

OUT OFFICES

Fig. 7.

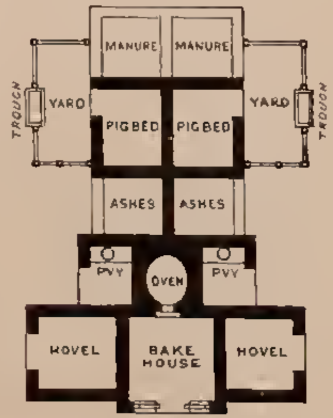


SIDE ELEVATION.

Fig. 8.

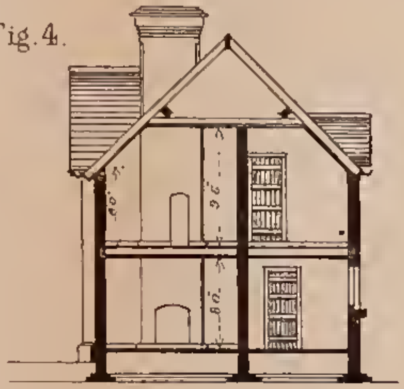
FRONT ELEVATION

Fig. 9.



PLAN.

Fig. 4.



SECTION.

Fig. 2.

END ELEVATION.

Fig. 6.

CHAMBER PLAN.

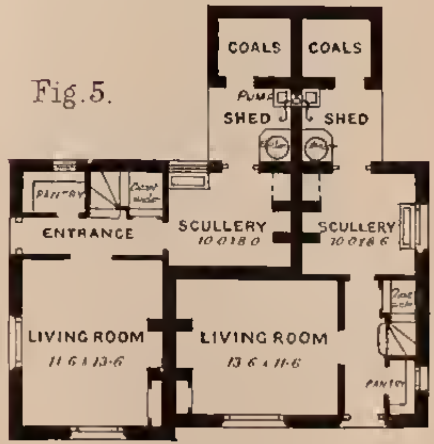
Fig. 3.

END ELEVATION.

Fig. 1.

FRONT ELEVATION.

Fig. 5.

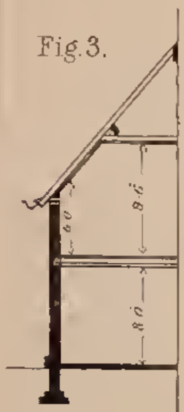


GROUND PLAN.

10 5 0 10 20 FEET

PLANS AND ELEVATIONS FOR ORNAMENTAL LABOURERS' COTTAGES, IMPROVED BY THE JUDGES FROM THOSE EXHIBITED AT CARDIFF BY "RUSTIC."

Fig. 3.



SECTION.

Fig. 2.

END ELEVATION

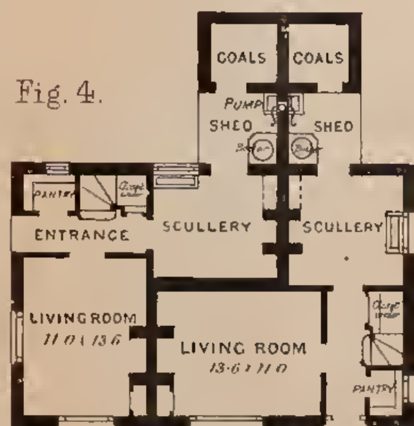
Fig. 5.

CHAMBER PLAN.

Fig. 1.

FRONT ELEVATION.

Fig. 4.



GROUND PLAN.

lated. The two front doors are well removed from each other, and on the chamber-floor there are three bedrooms, each entered separately, and of good size. But the originality of the plan which recommended it so strongly to the Judges, is the way in which the two cottages are locked together. Cottages built in pairs, and in some cases singly, usually take the form of the letter L, and when placed together back to back, they take the form shown in Fig. 3 or Fig. 4.

Fig. 3.

Fig. 4.

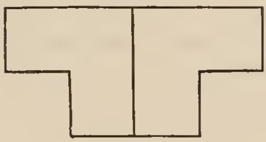


Fig. 5.

These entail breaks, valleys, and gutters; but in 'Rustic's' Plans we have an entirely different arrangement; the two blocks being locked together as shown in Fig. 5.

But although cottages whose plan forms an oblong without a single break, and the roof of which is one unbroken span, may be very well so far as accommodation and economy are concerned, yet it is necessary to take some care that an estate shall not be disfigured by the erection of cottages having only comfort and economy in view. The Judges therefore venture to submit the two designs shown on Plates I. and II., instead of Mr. Hine's; the one as being useful and economical, without being unsightly, the other as being somewhat more ornamental.

In these plans they have increased the size of the rooms on the ground-floor, which of course materially improves the bedrooms over; and they have shown the wall between the two cottages 9 inches thick instead of $4\frac{1}{2}$ inches, to exclude sound and to give greater stability to the building. They also recommend a steep pitched roof of tiles as preferable to a flat one of slates, as it reduces the height of the walls and gets more bedroom space in the roof: this, of course, necessitates dormer windows; but, with the break shown in the front, these windows improve the elevations. A porch is added to the front doors with the same object, and also to afford protection against the weather.

The out-offices are placed some distance from the houses, for obvious reasons; and they are grouped together as a separate building, containing a bakehouse common to the two cottages, hovels, and piggeries. It will be seen from the plan of the out-offices, that they can be built either with or without piggeries.

The design shown on Plate II., with its timbered gables, may be preferred in some localities. It is a more expensive mode of construction, but gives additional space. It will be observed that the gables are eorbelled out 16 inches; and the timber walls, brick-nogged and plastered externally, are only six inches thick, against nine-ineh brick walls; thus adding considerably to the size of the bedrooms, care being taken that this addition is given to the parents' bedrooms.

In conclusion, the Judges would add that the two designs are merely submitted as suggestions for carrying out a plan which they preferred, for reasons already given, to others submitted in competition at Cardiff; and they hope that the publication of this Plan may contribute, in some degree, to remove a difficulty felt on all estates, viz., the providing good cottages for agrieultural labourers at a moderate cost.

(Signed) GEO. HUNT,
C. RANDELL,
THOS. SAMPLE.

February, 1873.

VII.—*The Potato Disease.* By WILLIAM CARRUTHERS, F.R.S., Consulting Botanist to the Society.

THERE is reason to believe that the potato disease has been known for ages in the western countries of South America; but its first ascertained appearance was just thirty years ago, when it seriously injured the crops of the United States and Canada. It reappeared in the same regions the following year (1844). In the latter half of the month of July, 1845, it was first detected in the Old World, in Belgium, and within two months thereafter its occurrenee was recorded in England, Ireland, and Seotland, in Franee and Germany, Denmark and Russia. Since that time it has never been entirely absent from the potato crops, although in some years it has been mueh more destructive than in others. Its extensive prevalence last season, and the serious havoc it committed, threatening now a famine in some districts of Ireland, have drawn special attention to it recently, and have induced the President of this Soeiety (Earl Cathcart) to encourage the investigation of the nature of the disease by the offer of a Prize of 100*l.*, in the hope that sueh investigation will lead to practical suggestions as to a method of palliating, if not of curing, the malady.

With the approval of the Botanical Committee, I have drawn up the following short statement of the present state of knowledge regarding this disease:—

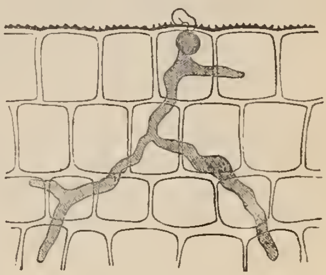
There is no longer any dispute as to its real cause. All the notions which supposed it to be produced by physical agencies, or to be the indication of a defective method of cultivation, or of a deterioration of the plant, have been conclusively set aside. Nor can it be held that the microscopic fungus, which is known to be invariably found in diseased potatoes, is the result of the disease and not its cause, since De Bary has produced the disease by placing the spores of the fungus on the leaves and tubers of healthy potatoes.

Beginning this narration with De Bary's experiment,* we may trace intelligently the history of this baneful parasite, and notice the nature and progress of the injury it produces in the potato. The seeds, or more properly spores of the fungus, are minute ovoid bodies, so small that the greatest diameter is not more than the eight-hundredth of an inch long. When a spore rests on the under surface of a leaf, and there is sufficient moisture, it pushes out a slender tube, through a ruptured opening in its coat. This tube penetrates the epidermis on the spot where germination takes place or finds its way to one of the innumerable openings or stomates which abound on the lower surface of the leaf, and passing through the opening enters the tissues. The slender tubular root, called the mycelium, rapidly grows, pushing its way everywhere through the substance of the leaf. It branches and rebranches freely; the brown colouring matter contained in it gives the spotted appearance to the leaves, which indicates to the eye the existence of the disease. The mycelium sends out, through the stomates, branches into the air, that give a mouldy aspect to the under surface of the leaf. The ultimate branches of this external growth are somewhat interruptedly swollen, and many of them bear minute oval bodies at their extremities. These are the spores. The mycelium passes down the leaf-stalk into the stem; through this it obtains access to the other leaves as well as to the underground branches, and through them to the potatoes themselves, which are indeed only enlarged and shortened portions of the underground stem. De Bary placed some spores on the leaves of a healthy

Fig. 1.

Spores of *Peronospora infestans*, magnified 300 diameters. One of the spores germinating

Fig. 2.

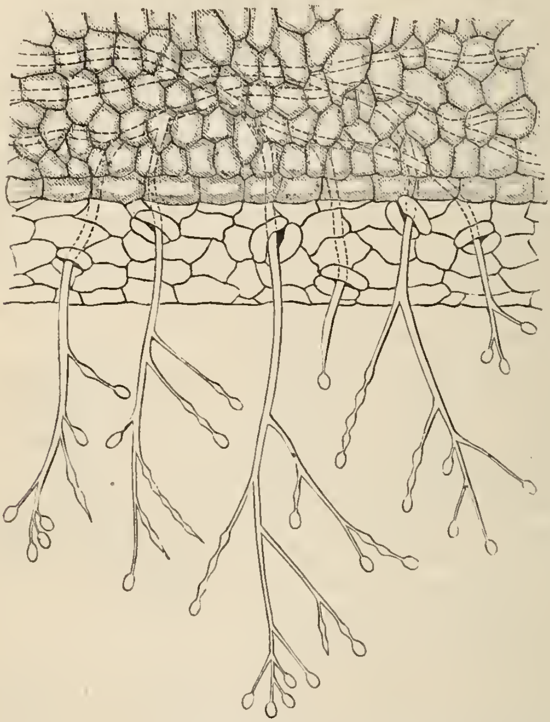


A spore which has penetrated the epidermis of the stem of a potato, and its mycelium root is penetrating the tissues of the stems.

* The elaborate Paper by De Bary on this and allied parasitic fungi will be found in the 'Annales des Sciences Naturelles, Partie Botanique,' 4th Series, Vol. XX. (1863) pp. 1–148. Plates I.-XIII.

potato on February 4th; the day following the tubes of the mycelium had penetrated the leaves; on the 8th the mould appeared on the under surface covered with fruit, and on the 9th the whole plant was diseased.

Fig. 3.—*Spore-bearing mould, Peronospora infestans.*
(Magnified 300 diameters.)



The spore-bearing mould springs from the mycelium, which penetrates the tissues of the leaf, and passes through the stomates on the under surface into the air.

The individual cells which are pierced by the mycelium are destroyed, and the starch-granules contained in the cells are attacked and consumed. Putrefaction soon begins, affecting first the cell-walls and then the starch. Payen has put it beyond doubt that the mycelium consumes the starch, for in his investigations he detected the granules attacked by the mycelium threads, and he made the injury more apparent by using iodine, the action of which on colouring starch granules is well known. By the ordinary processes all the starch can be separated from diseased potatoes, not only that contained in cells yet untouched by the mycelium, but even the granules that remain uninjured by the mycelium or the surrounding putrefaction.

The mycelium does not naturally fruit on the upper surface of the leaf, on the stem, or on the tuber of the potato, as these parts are either destitute of stomates or but partially furnished with them, and the mycelium does not send its fruiting branches through continuous epidermal structures; but when any of these parts of the potato, attacked by the parasitic fungus, are cut and placed in a moist atmosphere, the fruiting branches speedily appear.

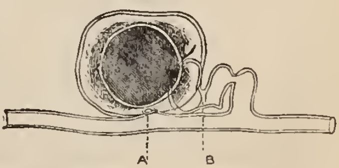
Some of the oval heads which terminate the branches are larger than the others, and contain within them from six to sixteen minute bodies. When water is applied either artificially or naturally, the outer covering bursts and the contents are liberated. Each of the little spores thus set free moves about in the water by the aid of two cilia. In a short time the motion ceases, and if a proper nidus exists, the spore germinates.

Fig. 4.—*Spores of* Peronospora infestans.

A. Large spores borne on the mould of *Peronospora infestans;* the contents of the cell divided. B. The small spores (zoospores) escaping from the cell. C. A zoospore with its two cilia. D. A zoospore deprived of cilia, and germinating. (Magnified 300 diameters.)

The minute fungus belongs to the genus *Peronospora*, and has received the name *Peronospora infestans*, Mont. Another method of reproduction has been noticed in other species of this genus, but it has not yet been detected in the case of the species causing the potato disease. In the other species the mycelium buried in the tissues of the supporting plant produces two kinds of cells, which have the same relation to each other that the ovule and the pollen grain have in flowering plants. The small cell, representing the pollen grain, when it comes into contact with the larger cell, pushes out a tube which penetrates its outer wall, and on reaching the inner wall induces changes which produce a ripe spore, called an oospore. The oospore is full of small granules, which are liberated, as in the fruit already described, on the application of water, and being furnished with cilia they move about for some time. Although these minute spores abound on and in the soil around the diseased plant, it appears that they never attack healthy plants through

Fig. 5.



A. Oospore of *Peronospora umbelliferarum*, Casp. B. Small antheridian spore. (Magnified 300 diameters.)

their roots, but that they attach themselves to the stems or leaves, penetrating their epidermis or pushing their way through the stomates.

It is to be hoped that the investigations on these fungi which will be undertaken in consequence of the offered prize, may lead to the discovery of these oospores in the *Peronospora* of the potato. As they are more especially rest-spores, supplying, along with the mycelium, the means of continuing the life of this species in a new season, their discovery and the determination of the part or parts of the plant in which they are produced may supply practical hints as to how to prevent the disease. Under any circumstances, however, and in order to secure the destruction of the parasitic fungus, the diseased plants—whether leaves, stems, or tubers—should be destroyed by fire. Leaving them to decay on the field, or neglecting them in the farmyard and permitting them to get into the manure, is a certain means of maintaining these rest-spores (oospores) and mycelium in a state ready to germinate when the necessary conditions are present.

It is further probable that when we have discovered the oospores in the potato fungus, which are known to exist in the other species of *Peronospora*, we shall not even then have ascertained the whole life-history of this parasitic fungus; for the recent investigations of De Bary have shown that many of the microscopic fungi, which have hitherto not only been considered different, but have been classed under different groups, are really stages in the life of the same plant. In the analogous changes in the higher cryptogams, the spores are produced only at the final stage; and among the different forms through which insects pass, only the imago or perfect insect has the power of continuing the species by producing eggs. But in these fungi each stage is spore-bearing. The investigations instituted for the offered prize may, it is to be hoped, disclose some stage in the progress of this parasite's life, where it can be more effectually dealt with than in that stage with which we are at present acquainted.

De Bary has shown by experiment that there is nothing in one potato plant more than in another to predispose it to the attack of the fungus. It is not weak or unhealthy plants that are attacked, but wherever the spores rest, and, finding the suitable moisture, germinate, there the disease will appear. When once the fungus has got a footing in a crop of potatoes, its rapid growth, the little time required to develop fruiting branches, and the innumerable number of spores produced, make its progress very rapid. Even when the disease is first noticed by the cultivator, it has taken such a hold of the crop that its cure is, I believe, impossible.

As moisture is so necessary to the development of the spores, every means should be adopted to prevent undue moisture. No soil is exempt; but there is less danger of an attack, and less injury when the disease makes its appearance, in thoroughly drained soils.

VIII.—*On Dodder.* By W. Carruthers, F.R.S., Consulting Botanist to the Society.

The dodders form a group of plants which are very closely related to the Bind weeds (*Convolvulaceæ*), yet are separated from them by many important characters. Some fifty species are recorded from all parts of the globe, and though they can be specifically distinguished, no peculiarities exist among them of sufficient importance to justify the establishment of generic groups. All are included in the one genus *Cuscuta* established by Linnæus.

They are all annual parasitic herbs, with thread-like stems, entirely leafless, or having the leaves represented by a few scattered minute scales. The small reddish flowers are united

Fig. 1.—*Trefoil Dodder* (Cuscuta epithymum, *var.* Trifolii).

into little round balls. Each flower produces four small seeds about the size of a grain of mustard. The mass of the seed consists of a fleshy albumen in which is spirally coiled a thread-shaped embryo. Gaertner first showed that, while these plants agreed in every way with other dicotyledons, they differed in the fundamental character expressed in the name, in having, as he supposed, only a single cotyledon in the embryo plant, but in reality this supposed cotyledon is only the axis or stem of the plant, without any leaf appendage whatever.

As all the dodders are annual, and they have no roots protected in the ground, the winter completely kills all the plants of each season's growth. The ripe seeds, however, supply the means in them, as in other annuals, of reproducing with the new season the destroyed plants of the last—for each perfect seed contains a minute bud capable, though separated from the parent plant, of maintaining a dormant existence, and, under suitable conditions, of starting into independent active life. Each seed encloses, either in the tissues of the embryo plant or surrounding it, a quantity of food sufficient to support the young plant until its organs are developed so far as to obtain its own food.

In *Cuscuta*, the albumen in which the embryo is enclosed supplies it with food enough to enable it to lay hold of the stem or branch from which it will draw its nourishment, if that is within reach. It is unable to maintain its life after this stock of food laid up by the parent is exhausted, so that it dies if it does not succeed in attaching itself to a living plant. Mr. Buckman has shown that, when sown with seeds of suitable plants, the ordinary internodal lengthening of the supporting stem lifts with it the young parasite from the earth. When, on the other hand, it attaches itself to grown plants, all connection with the earth is speedily cut off, and the lower extremity of the filiform stem is left suspended from the nourishing plant.

When the dodder touches the supporting plant it twines round the stem, and from the inner surface of the coil throws out a series of suckers, by which it secures a living connection with the stem. Through these suckers it withdraws the elaborated juices from the plant for its own use, and, from its rapid growth, it soon impoverishes, and ultimately kills, the supporting plant. It has already, however, thrown out branches by which it has seized hold of new plants, and it continues to extend its relations as long as the season permits the parasite itself to live. In this way a single plant, by its rapid growth, will cover in time several square feet of ground, and impoverish, or completely destroy, a great number of plants belonging to different natural orders. The most common British species, *Cuscuta epithymum*, Murray (of which the trefoil dodder, *C. trifolii*, Bab., is only a variety), was first noticed, as its name almost implies, growing on thyme, but it is found on other and very different plants, as on furze, broom, trefoil, lucerne, rock-rose

Figs. 2–4.—*Illustrations of Trefoil Dodder* (Cuscuta epithymum), *showing its anatomical relation to the supporting plant.*

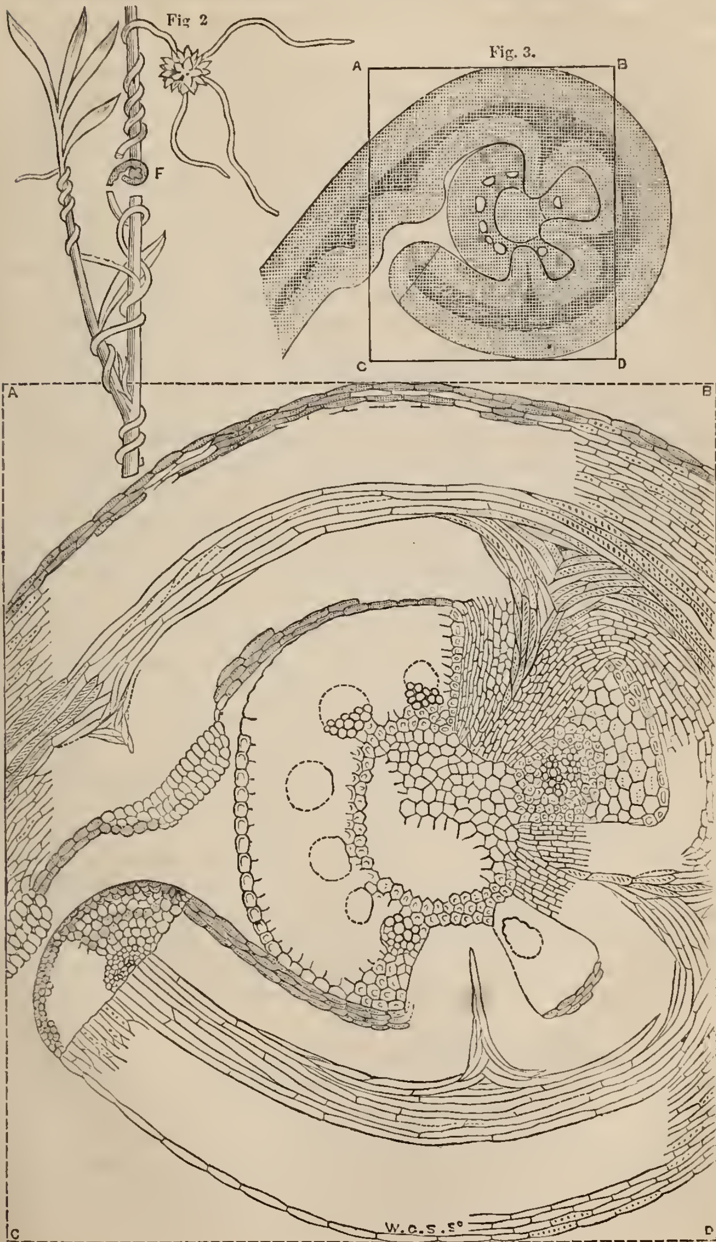


Fig. 4.

cranberry, heather, centaury, scabious, grass, and even on the brake. It is also found living on plants that are themselves partial parasites, like eye-bright, yellow-rattle, and bastard toad-flax.

Figs. 2–4 show the anatomical relation of *Cuscuta epithymum* to the supporting plant. Fig. 2 represents the *Cuscuta* twining round the stem of *Centaurea scabiosa*, Linn.—the Great Knapweed. At F the stem of the knapweed and the dodder is cut through, and this section is magnified ten times in the diagram, Fig. 3. The oblong portion indicated by the letters A B C D is still further magnified in Fig. 4, so as to show all the details of the structure. In the centre, the stem of the knapweed is shown cut across, exhibiting the cells of the pith, surrounded by the vascular and wood bundles, and these again enclosed by the bark. Three cones from the coil of the dodder penetrate the knapweed, reaching to the pith. These cones consist of the outer cellular covering of the stem, with a prolongation of the wood structure passing down their centre. Two suckers are shown pushing themselves out from the free portion of the stem of the dodder. The principal figure is from Chatiris's 'Plantes Parasites.'

The structure of the dodders, and the nature of the relation between them and the plants on which they are parasitic, have been investigated by Mirbel, Unger, and especially by Chatin. Being complete parasites they are without the food-producing or food-procuring parts of ordinary plants, viz., roots and leaves. Nor have they any of the green colouring matter (chlorophyl) which plays an important part in elaborating the food of vegetables, yet not an essential part, as is shown by the experiments of Saussure and De Candolle on *Atriplex hortensis rubra*, and *Ulva purpurea*. The minute scales and flower bracts, which are the only representatives of the leaves, are, as well as the stem, completely destitute of stomates.

The stem consists of a cellular pith surrounded by a wood structure, which differs, however, from the wood bundles of other dicotyledonous plants in being destitute of ducts, of medullary rays, and of liber. There is, consequently, no true bark; its place is occupied by a cellular layer surrounding the wood cylinder, the cells of which contain a red liquid, and are more or less charged with starch granules.

The suckers are developed from the stem. The flattened portion is derived from the external layer of cells. Through this is pushed a cone composed of the cellular pith and wood structures of the axis. These penetrate the stem of the supporting plant. It is not easy to understand how these delicate cell structures penetrate the firm fibro-vascular tissues while they are in active life. The same problem presents itself in investigating the growth of all the phaenogamous parasitic plants —of the mistletoe on the oak or apple, as well as the dodder on clover.

In penetrating the stem the tissues of the attacked plant are not injured; they are only pushed aside by the advancing cone, and the cells of the parasite are placed in such close relationship to those of the supporting plant that the organised juices pass freely from the one to the other, entering the dodder just as they would pass into a branch of the plant itself. The relation of parasitic fungi to the plants on which they grow is very different from what occurs in the dodders and the other higher parasites. The small roots, or mycelium of the fungi, penetrate the walls of the cells, and live upon the tissues themselves, or on the starch or other contents of the cells. The result is, consequently, the disorganisation and destruction of the plants attacked by the fungus. The higher parasites, on the other hand, only withdraw the organised juices. This operation is without any real injury to the supporting plant, if the proportion of the juice withdrawn by the parasite is small in relation to what exists in the whole plant, as is generally the case with the mistletoe on the apple: or it is fatal to the supporting plant, as in the case of the dodder on trefoil, where the rapid growth of a large parasite withdraws all the prepared food, and kills the plant by exhaustion. The enormous mass of the dodder also destroys the clover which it covers, by smothering it in the same way that any other heavy and dense covering would.

Of the many remarkable problems suggested by the study of the dodders none is more strange than the physiological inquiry as to how, without any appliances for obtaining food from the air or the soil, and entirely dependent on the prepared juices of the plants on which they live, they nevertheless contain in their tissues starch, resin, and different acrid substances which are not found in the nourishing plants, and, on the other hand, they want some of the chemical elements which abound in these plants. And, still further, how a single plant of dodder collecting its food from plants so different as clover, heather, thyme, and grass can convert the diverse juices of these various plants into products which are completely unlike any found in each or all of them.*

* The late Dr. Wolwitsch, the illustrious explorer of Western Tropical Africa, in a short paper "On the Loranthaceæ of Angola," a group of plants including our well-known mistletoe, refers to his own experiences of these parasites as follows: "It seems that the quality of the sap or juice of a tree exercises little or no influence upon the vegetation of *Loranthaceæ;* for in several instances I found one of the same species growing, equally vigorously, on *Adansonia*, which has a watery juice, and at another time on fig-trees, of which the sap is milky and glutinous."—*Journal Royal Hort. Soc.*, vol. iii. (1873) p. 122.

Considerable alarm has at times prevailed in various districts when the clover or flax has been extensively preyed upon by this dangerous parasite. The appearance was of course due to the use of seed (generally foreign) containing dodder. There is really no excuse for seedsmen permitting dodder to accompany clover seed, inasmuch as the small size of the dodder seed (being only half the size of clover) permits it to be easily separated by the mechanical process of sifting. When, however, the cultivator has the misfortune to discover dodder on his farm, he should use the utmost diligence to secure its destruction. No attempt at tearing the dodder to pieces will destroy it; indeed each separate piece that remains connected with the living plant will maintain its independent existence. Permitting the dodder to die on the field is also utterly worthless for the purpose of securing its extirpation, for the seeds remain, and when the spring returns they will germinate. The only efficient cure is to burn completely the whole vegetation of the diseased spot, together with the surface of the soil on which seeds may already have fallen.

Flax and clover crops are not the only ones that may be injured by dodder. The thyme-dodder, of which the clover-dodder is, as I have said, but a variety, has been found on plants belonging to the same genus with the potato; and my attention was drawn last autumn, by Mr. Brandreth Gibbs, to a crop of Swedish turnips attacked by this plague. The field was near Dunstable, on the Brandreth estate. The farmer, Mr. Scroggs, informed me that, two years before, the field had produced a good crop of trefoil, which was here and there affected by dodder. Mr. Scroggs cut down the clover, leaving the diseased plants to die on the ground, and then ploughed them into the soil. No indication of the parasite was detected in the wheat crop which followed the clover, but the plough having brought the seed again to the surface, it germinated after lying a year dormant, and attacked the crop of turnips then growing on the field. The suckers of the dodder had penetrated principally the fleshy stalk and midrib of the leaves, but not a few of the turnips themselves were also attacked on the upper surface.

IX.—*Annual Report of the Consulting Chemist for* 1872.

During the period from December, 1871, to December, 1872, 657 analyses have been referred to me by Members of the Society, being 73 less than in the preceding year, and an increase of 79 analyses over the number sent out in 1870.

An examination of the appended Summary, and its comparison with the Returns of analyses in 1871, will show that the analyses in 1871 were raised to an exceptionally high number by an unusually large number of cake and guano samples which were sent to me in that year. The abundance of green food in the past season no doubt rendered many farmers less dependent upon purchased food, and brought transactions in cakes and feeding-meals to their normal condition: in consequence, the unusually large number of 212 cake examinations made in 1871 was reduced to 165 in 1872, which, however, is an increase of 11 samples over the number of cakes examined by me for Members of the Royal Agricultural Society in 1870.

In the preceding year, as many as 78 guanos were sent for analysis, or 36 more samples than in 1872. The difficulty of procuring Peruvian guano in a dry powdery condition and of good quality, guaranteed by analysis, induced not a few who had long been in the habit of employing guano to substitute for its use nitrate of soda and various artificial manuring compounds, which appear to have reduced considerably the consumption of Peruvian guano.

Whilst the samples of guano were less numerous in the past season than in the preceding, fully as many artificial manures were referred to me for analysis in 1872.

By far the larger number of artificial manures examined by me in 1872 were well prepared and intrinsically valuable fertilisers, and comparatively speaking only few were not worth the money at which they were sold.

Bone-dust is getting dearer from year to year, and much difficulty is experienced in obtaining it clean and pure. Bone-dust is often mixed with glue-boilers' refuse-bones and bone-turners' refuse-dust, which although useful in their way, vary much in quality and composition, and for that reason should be sold separately for what they are worth, and not be mixed with fresh bone-dust.

Chincha Island guano being exhausted, the Peruvian Government agents now ship guano from the Guanape Islands. Nearly the whole stock in England has been imported from these islands, and only a few cargoes have lately arrived from Macabi Island, situated in the neighbourhood of the Guanape Islands. As far as I can judge from the examination of the cargoes of Macabi guano that have arrived here, it possesses about the same composition and general character as Guanape guano, and for all practical purposes may be considered as equal to the latter. The present importations of Guanape guano are drier and not so lumpy as a good many samples which were submitted to me for analysis in the preceding season. On an average, I find Guanape guano contains about 22 per cent of moisture, 30 per cent. of phosphates, and yields 12 per cent. of ammonia. In several samples of cargoes recently imported into England from the Guanape Islands, I find from 12 to 14, and in a few cases the guano yielded 15 per cent.; but, taking into account the average composition of Guanape guano, I do not think the buyer can count upon guano which yields more than 12 per cent. of ammonia, nor can he always depend upon being supplied with an article that is sufficiently dry and powdery to be economically applied to the land without having been previously mixed with some dry material and been reduced to a fine powder.

This operation is both troublesome and entails expense, and if the guano is very wet and lumpy, it is scarcely possible for the farmer, with the means at his command, to reduce such guano into a fine powdery condition.

Guanape guano, moreover, I find contains a good deal of free, or, more strictly speaking, volatile carbonate of ammonia, and in consequence loses in quality on keeping.

It is this volatile carbonate of ammonia which gives the pungent smell to Guanape guano, and which renders it liable to burn up the crop to which it is applied as a top-dressing, in case continued dry weather should set in directly after the top-dressing has been applied to the wheat or barley crop.

In order to meet the inconveniences which arise from the wet lumpy condition in which Guanape guano frequently reaches the continent of Europe, and to neutralise the pungent and injurious properties of the carbonate of ammonia, it is desirable to treat the raw guano with about 20 per cent. of oil of vitriol, and after this treatment to keep it in a heap for several months, and finally to reduce the sulphated guano by suitable means into a fine and dry powder.

By these means a very superior fertiliser is obtained, which possesses many advantages over wet raw Peruvian guano. It is, however, difficult on a small scale to treat Peruvian guano with sulphuric acid, and to convert it into a dry and soluble fertiliser.

Soluble and ammonia-fixed Peruvian guano is highly spoken of both in this country and on the Continent, particularly in Germany, by farmers who have tried its effects in the field, in comparison with the raw Peruvian guano. In order to meet the increasing demand for soluble guano, extensive works were established a few years ago at Hamburg, for the manufacture of sulphuric acid, and the preparation of soluble Peruvian guano. In these works the Peruvian guano is dried if necessary, sifted, and then treated with just sufficient sulphuric acid to convert the volatile carbonate of ammonia of the raw guano into non-volatile neutral sulphate of ammonia, and at the same time to render the greater part of the insoluble phosphate perfectly soluble in water. By these means a highly concentrated, dry, and finely powdered fertiliser is produced, which may be said to combine the qualities of a good superphosphate with those which are characteristic of Peruvian guano.

Although the prepared guano is sold at about 10*s*. more per ton than Peruvian guano in its natural condition, the sales of the soluble guano in Germany have steadily increased from year to year, and last year I am informed that they amounted to more than 60,000 tons.

Two samples of soluble Peruvian guano, recently analysed by me, had the following composition:—

Composition of two Samples of Soluble Peruvian Guano.

	Sept. 1872.	Dec. 1872.
Moisture	14·65	16·78
Water of combination and *Organic matter	42·57	41·88
Biphosphate of lime (mono-basic phosphate of lime)	13·86	13·20
Equal to bone-phosphate (tri-basic phosphate of lime) rendered soluble by acid	(21·71)	(20·68)
Insoluble phosphates	5·09	7·19
Sulphate of lime	16·36	13·39
Alkaline salts and magnesia	3·78	4·39
Insoluble siliceous matter	3·69	3·17
	100·00	100·00
* Containing nitrogen	8·72	8·96
Equal to ammonia	10·59	11·88

It will be seen that the soluble guano which is prepared at Hamburg contains from 20½ to 21¾ per cent. of soluble phosphate, from 5 to 7 per cent. of insoluble guano phosphates, and nearly as much ammonia as Guanape guano in its natural wet condition.

There can be no doubt that Peruvian guano, treated with acid and sold in a dry and fine condition, and with the guarantee of containing 21 per cent. of soluble phosphate and 11 per cent. of ammonia, will find a more ready sale than raw guano, which is still sold without any guarantee whatever as to quality. Guanape guano is frequently far too damp and sticky for application to the land in its natural condition, and it often contains no more ammonia than is supplied in the prepared guano, the quality of which is guaranteed by analysis. It is, therefore, manifestly to the advantage of the farmer to buy the prepared Peruvian guano in preference to raw, even if he should have to pay a somewhat higher price than that at which the raw guano is sold.

In consideration of the difficulties which at present exist in the way of procuring Peruvian guano of a uniform composition and in a dry and fine condition, arrangements have been made to set up sulphuric acid chambers and works at Victoria Docks, in which the preparation of soluble Peruvian guano will be carried out on an extensive scale.

It is to be hoped that before next spring is far advanced, the works at present in the course of erection at Victoria Docks will be in fair working order, and that before long the British farmer will be supplied with as good a fertiliser as the farmers of Germany, whose experience has taught them to appreciate the high fertilising value of the soluble guano, which for some years has been prepared on a very large scale at Hamburg.

Attention has been directed in public papers to some newly discovered guano-deposits in Patagonia. Judging from the geographical position of the district where these new guano deposits occur, it appeared to me scarcely likely that the new Patagonian guano would approach in quality the Chincha Island or Guanape Island deposit. A recent analysis of Patagonian guano has fully confirmed this view, as will be seen by the following figures.

Composition of a sample of Patagonian Guano.

Moisture	35·86
*Organic matter and ammoniacal salts	26·07
Phosphate of lime	22·01
Carbonate of lime	5·64
Alkaline salts	7·34
Insoluble siliceous matter	3·08
	100·00
* Containing nitrogen	4·42
Equal to ammonia	5·37

Fully one-third of this guano consists of water, and it is therefore scarcely necessary for me to add that the condition of the sample analysed by me was very wet and lumpy.

Whilst speaking of guano, I may mention that a variety of a dry and finely powdered guano has recently been imported into England under the name of Mejillones guano.

Mejillones guano is a valuable natural guano deposit, which, however, differs essentially in its composition from Peruvian guano, as will be seen by the subjoined complete analysis of an average sample taken from a cargo landed in England last spring.

Composition of a sample of Mejillones Guano.

Moisture	7·09
*Organic matter	7·44
†Phosphoric acid	33·97
Lime	37·01
Magnesia	2·83
Chloride of sodium	2·87
Potash	·34
Sulphuric acid	2·53
‡Carbonic acid	2·76
Oxide of iron	·69
Insoluble siliceous matter	2·47
	100·00

* Containing nitrogen	·93
Equal to ammonia	1·12
† Equal to tribasic phosphate of lime	74·15
‡ Equal to carbonate of lime	6·25

It will be seen that Mejillones guano is very rich in phosphate of lime, but that it yields only one per cent. of ammonia. Although it may be applied without further preparation as a manure for root crops, it is more advantageously treated with sulphuric acid, and converted thereby into a high-class, soluble guano superphosphate.

Another valuable phosphatic guano, containing still less nitrogen than Mejillones guano has been introduced into commerce from Curacao Island in the West Indies.

The average composition of good samples of Curacao guano is fairly represented by the following analysis:—

Curacao Phosphate.

Moisture	8·72
Organic matter	5·79
*Phosphoric acid	33·51
Lime	43·01
†Carbonic acid	2·96
Magnesia, alkalies, &c.	5·71
Sand	·30
	100·00

* Equal to tribasic phosphate of lime	73·15
† Equal to carbonate of lime	6·72

The utilisation of various waste products for agricultural purposes is no longer neglected, but is receiving more attention in all civilised countries. Unfortunately the manufacture of many refuse matters into dry portable manures is attended with so much expense that the manufacture of fish-refuse, of blood and the carcases of dead animals, &c., leaves but a small margin for profit.

Fish-refuse, if it can be bought at a price corresponding to its intrinsic fertilising value, is a useful manure for wheat or barley.

Frequently, however, portable fish manures are sold at too high a price in comparison with the price at which other artificial manures can be bought. In illustration of this fact I may quote the following analysis of a sample of fish manure, which was sold at 3*l.* 5*s.* per ton to a member of the Society.

Composition of a sample of Fish Manure.

Water	60·17
*Organic matter	14·70
Phosphate of lime	3·99
Carbonate of lime	15·31
Alkaline salts (common salt)	2·29
Insoluble siliceous matter (sand)	3·54
	100·00
* Containing nitrogen	·84
Equal to ammonia	1·02

This manure, it will be seen, contained a large proportion of water, much carbonate of lime, and scarcely 4 per cent. of phosphate of lime, and its organic matter yielded only 1 per cent. of ammonia. The fertilising value of this manure, I need hardly say, depends mainly upon the amount of phosphates and nitrogenous matters which it contains; and, as the foregoing quantities can be bought in a more portable and concentrated form in Peruvian guano, at about 1*l.* 5*s.* a ton, this fish manure was sold at about three times as much as it was worth. A similar fish manure, but of a better quality than the preceding sample, was sold to another member of the Royal Agricultural Society at 5*l.* a ton, with the understanding that if on analysis I did not find it worth 5*l.*, the purchaser would have to pay only the price which was put upon the manure by me. The policy of buying fish, and other refuse manures, subject to analysis, will be recognised from the fact that this fish manure was found to be worth only 3*l.* 10*s.* a ton.

In further illustration of these remarks, I would direct attention to the subjoined analysis of a sample of night-soil manure, produced by Goux's patent system.

Composition of a sample of Night-soil Manure obtained by Goux's Plan.

Water	31·16
*Organic matter	23·20
Oxide of iron and alumina	12·31
Phosphate of lime	1·31
Sulphate of lime and a little carbonate of lime	5·04
Alkaline salts and magnesia	3·19
Insoluble siliceous matter	23·79
	100·00
* Containing nitrogen	·94
Equal to ammonia	1·14

This manure was sold at 4*l.* a ton, but, as it yielded only about 1 per cent. of ammonia, and contained not quite 1½ per cent. of phosphate of lime, it was clearly sold at far too high a price.

The majority of the samples of fish manure which have been brought under my notice at various times, I found too dear at the price at which they are usually sold, and, generally speaking, they are manures of comparatively low quality.

On the other hand, a very valuable and concentrated manure has lately been imported into England from South America and from Australia in the shape of dried meat fibre, the refuse of factories in which Liebig's Extract of Meat is made.

Two samples of dried meat-fibre refuse — one from South America and another from Australia—had the following composition:—

	South America.	Australia.
Moisture	9·07	6·73
*Organic matter	87·41	89·54
Phosphate of lime	3·52	·89
Carbonate of lime and Alkaline salts		1·13
Sand		1·71
	100·00	100·00
* Containing nitrogen	11·97	10·94
Equal to ammonia	14·67	13·28

Several cargoes of a similar manure have lately been imported into England from New Orleans, under the name of Azotene or animal guano.

A sample of this manure I found contained in 100 parts:—

Moisture	11·26
*Organic matter	80·31
Phosphate of lime	3·09
Carbonate of lime and alkaline salts	4·65
Sand	·69
	100·00
* Containing nitrogen	11·34
Equal to ammonia	13·77

It was more finely prepared than the preceding meat-fibre, and, in addition to having an equally high percentage of nitrogen, contained more phosphate of lime than the latter.

Another description of animal guano imported into England from our Australian colonies, and lately analysed by me, had the following composition:—

Moisture	18·20
*Organic matter	41·78
†Phosphoric acid	15·01
Lime	18·52
Alkaline salts	·90
Insoluble siliceous matter	5·59
	100·00

* Containing nitrogen	3·85
Equal to ammonia	4·67
† Equal to tribasic phosphate of lime	32·75

Judging from its composition and general appearance, this animal guano appears to be a mixture of steamed bones, dried blood and meat-fibre, ground into a tolerably fine powder. It is, no doubt, a useful artificial manure, but it is scarcely as valuable as fine and clean bone-dust.

In my last Report I directed attention to the fact that many villages and isolated dwellings are not well supplied with good wholesome drinking water, and that, as a rule, the water in towns is purer than in the country. I have now to report that, during the last twelve months, as many as fifty-three samples of water were sent to me for examination by members of the Society. A considerable number of these waters I found unmistakably contaminated with sewage products, and utterly unfit for drinking purposes; and I would again direct attention to the fact that the bad quality of the water which is employed in country places for drinking and general domestic purposes is a cause of the prevalence of low fever, and other disorders, in not a few localities. If a drinking water appears more or less coloured, and at the same time has a disagreeable smell, or should it not be quite clear and exhibit particles of white flocculent matter, I would urge upon those who habitually use the water to discontinue its use at once, and to have it submitted to a thorough chemical analysis without delay.

Amongst the matters of interest to the agriculturist, which have been referred to me during the last twelve months, I received a sample of compressed yeast, with the request to ascertain its composition and nutritive value. The following results were obtained:—

Composition of Compressed Yeast.

Moisture	73·19
Oil	·27
*Albuminous Compounds	13·31
Gum, sugar, &c.	9·16
Cellular fibre	1·35
Mineral matter (ash)	2·72

Consisting of :—		
Earthy phosphates	·597	
Phosphoric acid	1·322	
In combination with :—		
Alkalies	·729	
Silica	·072	
		100·00
* Containing nitrogen		2·13

Compressed yeast, when mixed with hay and straw-chaff, has been found a useful article of food, especially for milking-cows. The large amount of albuminous or nitrogenous compounds in the dry substance of yeast, and its richness in earthy and alkaline phosphates, throw light on the utility of yeast as an auxiliary food for milk-cows: for milk, as is well known, abounds in earthy and alkaline phosphates; and the casein or curd of milk is analogous in composition with the nitrogenous or albuminous compounds of yeast.

In former reports I have repeatedly directed attention to the fact that the fattening properties and commercial value of palm-nut meal depend, in a great measure, upon the percentage of oil and fatty matter which a particular sample may contain; and I have advised intending purchasers to request of the dealer to guarantee the percentage of oil or fat in the palm-nut meal he offers for sale.

It is not enough that he should give a general guarantee to deliver genuine palm-nut meal, for the meal may be perfectly genuine, and at the same time be very poor in oil, which is by far the most valuable of all food-constituents.

A sample of palm-nut meal, unusually poor in oil and fatty matter, has lately been sent to my laboratory. The subjoined analysis, indeed, shows that, practically speaking, it contained merely traces of oil, and was much inferior to good palm-nut meal.

Composition of a sample of inferior Palm-nut Meal.

Moisture	10·88
Oil	·40
*Albuminous compounds	18·44
Mucilage and digestible fibre	42·91
Woody fibre (cellulose)	22·01
Mineral matter (ash)	5·36
	100·00
* Containing nitrogen	2·95

This meal was sold at Liverpool at 4*l.* a ton, but, although it was sold at 2*l.* 10*s.* less money than palm-nut meal, which is made at Liverpool, and sold by the following guaranteed analysis,

Moisture	5·92
Oil and fatty matter	20·01
*Albuminous compounds	13·87
Mucilage, sugar, and digestible fibre	38·24
Woody fibre (cellulose)	18·56
Mineral matter (ash)	3·40
	100·00
* Containing nitrogen	2·22

it is, in reality, the dearer meal of the two. Palm-nut meal, containing 20 per cent. of oil and fatty matter, in my judgment is worth *3l.* more per ton than the meal which was offered for sale at *4l.*; and as the price of the superior palm-nut meal was *6l.* *10s.* a ton at Liverpool, the apparently cheaper meal, which was almost entirely destitute of oil and fatty matters, was, in reality, *10s.* per ton dearer than the more expensive meal. In explanation of the unusually low percentage of oil in the inferior meal, I may mention that a few years ago a process was discovered of extracting the oil from oily seeds, &c., by means of sulphide of carbon. This chemical operation appears to have been most successfully carried out in the case of the cheap palm-nut meal, which probably came from Hamburg, where works for the extraction of oil from oleaginous seeds have been in existence for some years past.

Analyses made for Members of the Royal Agricultural Society, from December, 1871, *to December,* 1272.

Guanos	42
Superphosphates, dissolved bones, wheat manures, and similar artificial manures	204
Bone dust	26
Nitrate of soda and sulphate of ammonia	28
Potash salts	7
Soot	6
Refuse manures	27
Marls, limestones, ironstones, and other minerals ..	23
Soils	32
Oilcakes	165
Feeding meals	10
Vegetable productions	15
Whey and cheese	5
Waters	53
Sewage	2
Examinations for poison	12
Total	657

X.—*Quarterly Report of the Chemical Committee, December,* 1872.

Dr. Voelcker reports a case of rape-cake which was purchased for manuring purposes by Mr. James Blyth, Weasenham, Brandon, Norfolk.

The sample was sent in a broken state, and on inspection appeared to consist of pieces of rape-cake and fragments of other descriptions of cake.

Mr. Blyth wrote to Dr. Voelcker:—"In reply to your inquiry, the rape-cake was purchased for manure, but, as from the sample you have, it was sent in that mixed state, although sold as all rape-cake. From an inspection of it in a lump, it appears a general mixture of all kinds of things.

"Will you kindly analyse it as mixed, and state its worth as manure, the price being 6*l.* 15*s.* per ton.

"Yours faithfully,
"James Blyth."

The following results were obtained in the analysis of this broken cake:—

Composition of Manuring Rape-cake sent by Mr. James Blyth, Weasenham, Brandon, Norfolk.

Moisture	8·24
*Organic matter	82·40
Phosphates	2·56
†Alkaline salts	4·08
Insoluble matter	2·72
	100·00
* Containing nitrogen	3·18
Equal to ammonia	3·86
† Containing phosphoric acid	·24
Equal to tribasic phosphate of lime	1·58

On further examination, the sample sent by Mr. Blyth was found to be rape-cake mixed with pieces of Bassia-cake. Good manuring rape-cake, the market value of which at the time was 6*l.* 15*s.* per ton, contains about 5 per cent. of nitrogen, nearly 2 per cent. more than this mixed cake, and is worth from 25*s.* to 30*s.* more per ton than the cake sent for analysis.

With regard to feeding cakes, Dr. Voelcker reports the following cases:—The Rev. Thos. Best, of Red Rice House, Andover, sent a sample of linseed-cake, which was found to be adulterated with earth-nut-cake and buck-wheat. Another sample of the cake was subsequently sent by Mr. Best, who stated that the cake cost him 12*l.* per ton ready money, and that he bought it as the *best* English linseed-cake.

This cake had the following composition:—

Composition of a Sample of Linseed-cake sent by Rev. Thos. Best, Red Rice House, Andover.

Moisture	11·72
Oil	9·80
*Albuminous compounds (flesh-forming matter) ..	22·50
Mucilage, starch, and digestible fibre	37·10
Woody fibre (cellulose)	13·48
Mineral matter (ash)	5·40
	100·00
* Containing nitrogen	3·60

It will be seen that this cake is both deficient in oil and albuminous compounds. It was adulterated with earth-nut-cake and buck-wheat, and probably not worth more than 10*l.* per ton. No reply has been given to applications for the name of the vendor.

A sample of oil-cake was sent by Mr. B. Smithin, Dumbleton, who wrote on the 25th July, 1872:—"Dear Sir,—I send by this post a sample of oil-cake, which I wish you to analyse. I have been giving it to rearing calves and have lost five, and think there must be something wrong with the cake."

The cake had the following composition:—

Composition of a Sample of Cake sent by Mr. B. Smithin, Dumbleton, Evesham.

Moisture	9·60
Oil	11·24
*Albuminous compounds (flesh-forming matter)	25·56
Mucilage, starch, and digestible fibre	36·52
Woody fibre (cellulose)	10·16
Mineral matter (ash)	6·92
	100·00
* Containing nitrogen	4·19

Dr. Voelcker reports that this was not a pure linseed-cake, although sold at 11*l.* 10*s.*, the price of pure cake, it being made from dirty linseed, containing a number of small weed-seeds that are usually present in unscreened linseed, and starchy matter, which does not occur in pure linseed-cake, but that he could not detect any poisonous ingredient in it. Dr. Voelcker has frequently pointed out the danger of using such cakes, but as this parcel was invoiced as oil-cake, and not as linseed-cake, the Committee do not feel legally justified in publishing the names of the vendors.

XI.—*Quarterly Report of the Principal of the Royal Veterinary College.*

Dec. 9, 1872.

Sir,—I have the honour to send you the subjoined Report on the general state of the health of cattle and sheep during the past three months.

With the exception of those maladies which pass under the ordinary name of epizootics, such as "foot-and-mouth disease," "pleuro-pneumonia," &c., other diseases have not been very prevalent among these animals.

This, perhaps, was hardly to be expected when the extraordinary rainfall which has prevailed throughout the period is considered; an explanation, however, of the circumstance may probably be found in the fact that throughout the whole time an elevated temperature has chiefly prevailed. If, on the contrary, a low temperature had existed with the excess of wet, it is not too much to affirm that the health of all animals would have suffered in proportion. At present it may be too early to assert that the elevated temperature has, as in former seasons of a like kind, been quietly operating in the production of a disease which experience has shown to be one of the most destructive to which sheep are especially disposed, namely, the "rot."

Under these circumstances it behoves flock-masters to be on their guard against the inroads of this insidious and destructive malady by giving their sheep as much dry and nutritious food, mingled with a small portion of salt, day by day, as will keep up the strength of the animal's constitution and be prophylactic against the liver-fluke, upon which the disease depends. For details in the management of sheep under such circumstances, I may refer agriculturists to a paper on the causes, pathology, and treatment of rot, published by me in the Society's 'Journal' for the year 1862.

With reference to parasites and parasitic diseases in general, I have to report that both calves and lambs—the former more especially—have suffered rather severely in some districts from attacks of the lung-worm—*Strongylus bronchialis.*

As is often the case, however, the calves in other localities which do not apparently differ either in the character or the cultivation of the soil, or in the system of rearing young stock, have escaped;—a mystery which science has still to unveil.

The whole subject of parasitism is receiving the special attention of the College, the importance of it having led the Governors of the Institution to create a new professorship almost exclusively for its investigation. Dr. Cobbold, who holds the chair, is now daily engaged in delivering lectures to the students, and in conducting experiments. Very recently a calf and lamb had administered to them several segments of those varieties of the tape-worm, well filled with matured ova, on which the so-called "measle," or rather "mizzle," of beef and mutton are believed to depend. The "measle" is in reality an embryotic tape-worm, or a tape-worm in its larval or hydatid stage of development from the ova, which, on entering the digestive organs of man, in its living condition in beef or mutton, quickly matures into the perfect entozoon, often many feet in length. A period of three months at least is necessary for the development of hydatid embryos from the ova; and should success in these cases attend the exhibition of the ova, it may be hoped that the experiments will be sufficiently complete to be communicated to the Society in the next quarterly Report.

It will be in the remembrance of the Society that a year since an inquiry into the ravages committed by the *Strongylus bronchialis* was undertaken at the request of the Lincolnshire Agricultural Society—that county having often suffered severe losses by the death of lambs from attacks of the parasite. A series of questions has been circulated by the Society among its members and others, and the answers already received have been arranged, but no correct conclusions can be arrived at until certain experiments now being conducted are completed. These experiments have for their immediate object the further elucidation of the natural history of the entozoon, more especially during the period of its existence extern to the bodies of its victims.

Referring again to the lung-worm of the calf, it may be stated that the parasite gives rise to the disease commonly known by farmers as the "hoose or husk," from the peculiarity of the cough of the affected animal. The malady is accompanied with great emaciation of the animal, so that death not unfrequently results from inanition and persistent irritation, as well as from the structural changes which take place in the lungs. The cure lies chiefly in the early destruction of the worms, and for this purpose medicated inhalations are of essential service. These are best applied by burning tar in a shed in which the calves are temporarily confined, and casting sulphur on the flame from time to time, care being taken that there is a sufficiently free access of air to prevent suffocation.

The exhibition of oil of turpentine, tincture of assafœtida, decoction of savin, and other allied agents, will also effect much good. To these remedies should succeed tonics both mineral and vegetable, of which the preparations of iron and the barks are the best.

Epizootics.

Cattle-Plague.—The chief event in connection with this destructive class of diseases has been the recent outbreak of cattle-plague in the East Riding of Yorkshire. Like the outbreak of 1865, the disease was brought here by animals exported from Russia. In 1865 the cattle came direct from Revel, *viâ* the Baltic, to the port of Hull: in 1872 they were brought from Cronstadt, having been first taken there from the province of Petersburgh. It is also a singular coincidence that the infection in the recent outbreak spread from the port of Hull, having doubtless first reached the cattle-market of that place by persons passing between the markets and the ship while lying in dock with the diseased cattle on board. Happily the country may be congratulated in being again free of cattle-plague. Inquiries just completed have shown that at Patrington, where the disease first broke out, no case has occurred for more than two months. The fields have been top-dressed with lime, the sheds disinfected, and fresh cattle brought to the premises.

In the Pocklington district, where the plague was detected on August 27th, and continued, in spite of the measures which were employed to eradicate it, for nearly two months, no fresh case has occurred for nearly six weeks. It may be therefore fairly concluded that the disease is thoroughly exterminated in that locality.

In the Bridlington district, the disease has also been stamped out, and the fields in which the animals were killed and buried re-occupied by cattle.

The following statistical return shows the total loss of cattle which has been sustained :—

Number of cattle on infected farms and premises, but all not necessarily in contact with the diseased, 289.

Attacked, 72 :

Killed, diseased	51
Died	21
Total ..	72
Killed, healthy	171
Escaped	46
	289

Pleuro-pneumonia.—With regard to the disease designated by the term pleuro-pneumonia, there are many reasons to fear that it is on the increase in different parts of the country, although on the whole no material addition has taken place in the number of cases officially reported.

Two causes especially are in operation to keep the disease rife, viz., a desire to treat the animals rather than to send them at once to the slaughter-house, and a disposition to conceal from the authorities the existence of the malady on the farm. Pleuro-pneumonia possesses properties which differ in many respects from those of other infectious cattle-diseases; and doubtless the so-called cured animals are often dangerous *foci* of infection to others. It may not be a difficult problem to fix the time of the commencement of infection, but when the *materies morbi* cease to emanate from the diseased animal, or to be so changed as to be non-productive of mischief to others, must be purely conjectural. The true policy of the agriculturist is therefore to send for slaughter every animal, the subject of pleuro-pneumonia, as early as possible after the declaration of the disease.

Foot-and-Mouth Disease.—Under the circumstances of a special investigation into the several causes which are in operation to extend the area of this affection, and to lead to its repeated outbreaks in the same district, having been undertaken by the Society, little need be said in this Report. Severe and long-continued as the recent outbreak of foot-and-mouth disease has been, it has thrown no additional light on the pathology of the affection, nor on the laws which govern its extension. The facts developed to-day are identical with those which existed in 1839, when the first cases of "foot-and-mouth disease" were observed in England. The years 1840 and 1841 witnessed the same malignancy and the same victims of the malady, viz., cattle, sheep, and pigs, as 1871 and 1872 have done. There are now many indications that the disease is again on the decline, so that ere long we may hope it will assume that which may perhaps be called its normal condition.

The fatality of the affection is small, and the agriculturist should take care that he does not increase this, nor protract what would otherwise prove speedy natural cures by too great a desire to dose animals with medicinal agents. Care in protecting the diseased animals from inclement and all extremes of weather, and good nursing, are the principles which should rule in the management of animals affected with the foot-and-mouth disease.

I have the honour to be, Sir,

Your obedient servant,

JAS. B. SIMONDS.

H. M. Jenkins, Esq.

JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

XII.—*Report of Experiments on the Growth of Barley for Twenty Years in succession on the same Land.* By J. B. Lawes, Esq., F.R.S., F.C.S.; and J. H. Gilbert, Ph.D., F.R.S., F.C.S. (*continued from* p. 162).

Section II.—Average Annual Produce by each Description of Manure employed.

In this section the object will be to consider more exclusively than hitherto the effects of different manures on the barley-crop; to ascertain what conditions of manuring are the best adapted for the crop in the soil in question; to determine in what constituent, or class of constituents, the soil soonest shows signs of exhaustion by its growth; and to compare the characters of barley with those of wheat in these respects. To this end attention will chiefly be confined to the average results obtained by each manure over a series of years, so as to exclude, as far as possible, the influence of variations of season, the full consideration of which already has so clearly indicated, and so greatly limited, the necessary reference to it here.

With regard to the soil, as already stated, the experimental barley-field immediately adjoins the experimental wheat-field. The soil of both may be described as—"a somewhat heavy loam, with a subsoil of raw yellowish red clay, but resting in its turn upon chalk, which provides good natural drainage." Lastly, the wheat-field is artificially pipe-drained, but the barley-fieldis not.

The particulars of the manuring, and of the average annual produce, and increase, by manure, on each plot, over the twenty years, are given at one view in the folding Table (XXIV.) facing the next page. The full details will be found in the Appendix Tables (pp. 163-185); and such abstracts as may be needed for the illustration of individual points will be given as we proceed.

Average Annual Produce without Manure.

From the commencement, two plots, at some distance from one another, have been left unmanured; and a third has received, every year, a dressing of ashes (burnt soil and turf), at the rate of 20 bushels per acre per annum. This is much more than the quantity of the same description of ashes mixed with the various artificial manures to aid their even distribution over the land. The experiment was arranged to meet the cavil of Baron Liebig, that inasmuch as we had mixed "ashes" with our manures, we could not form any judgment as to the effects of the latter; and that doubtless part of the effect we attributed to them was due to the "ashes" also employed.

Table XXV. (see next page) gives the average annual produce on these three practically unmanured plots, over the first ten, the second ten, and the total period of twenty years.

Looking first to the quality of the produce, the average weight per bushel of dressed corn is, on all three plots, considerably higher, and the proportion of corn to straw is either higher, or but little lower, over the last than over the first 10 years.

This result is doubtless due, in great measure, to the character of the seasons; but the fact may be taken as at any rate sufficient evidence that there was no deterioration in the character or health of the plant, from growing the same crop year after year on the same land.

The two unmanured plots, at opposite sides of the field, show an average annual difference, over 20 years, of 2 bushels of corn and $\frac{5}{8}$ cwt. of straw, but considerably less over the last 10, than over the first 10 years. This indicates probably, that the result is, in part, at any rate, due to a difference of condition from previous manuring and cropping, which is becoming gradually reduced, and so the plots the more equalised. It is a question, however, whether the staple may not be rather better on Plot 6–1 than on Plot 1 O.

On the other hand, the average produce on Plot 6–2, receiving annually 20 bushels of soil and turf ashes per acre, is only precisely the same in corn, and even rather less in straw, than on the immediately adjoining plot (6–1), which is entirely unmanured. Over the first 10 years, indeed, the ashed plot gave rather less, both corn and straw, than the entirely unmanured one, though rather more of both over the second 10 years. Possibly, therefore, under the exhausting process of growing the crop year after year on the same land, the small amount of manurial matters supplied in the ashes may eventually—that is after, so to speak, all the previously acquired *condition* is worked out of the soil

EXPERIMENTS ON THE GROWTH OF BARLEY YEAR AFTER YEAR ON THE SAME LAND, WITHOUT MANURE, AND WITH DIFFERENT DESCRIPTIONS OF MANURE. HOOS FIELD, ROTHAMSTED.

TABLE XXIV.—Average Produce, and Increase by Manure, per Acre, per Annum, over Twenty Years, 1852–1871.

[The Increase by Manure is in all cases given over the unmanured Produce (mean of Plots 1 O and 6–1); also, when Mineral and Nitrogenous Manures are used together, over the produce by the corresponding Mineral Manure alone (*i.e.* Plots 2 A, 2 AA, 2 AAS, 2 C, over 2 O; 3 A, 3 AA, 3 AAS, 3 C, over 3 O; and so on.)]

NOTES.

(1) "3½ cwts. Superphosphate of Lime"—in all cases, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric acid sp. gr. 1·7 (and water).

(2) Sulphate Potass—300 lbs. per annum for the first 6 years, 1852–7.

(3) Sulphate Soda—200 lbs. per annum for the first 6 years, 1852–7.

(4) "Ammonia-salts"—in all cases equal parts of Sulphate and muriate of Ammonia of Commerce.

(5) Plots "AA" and "AAS"—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) Plots "AAS"—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 comprise, respectively, one-half 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 6 years, and 1000 lbs. only each year since.

(8) 300 lbs. Sulphate Potass, and 3½ cwts. Superphosphate of Lime, without Nitrate of Soda, the first year (1852); Nitrate alone each year since.

(9) Sulphate Soda—200 lbs. per annum 1855, 6, and 7.

Plots.	Manures per acre, per annum (*unless otherwise stated in the side-notes*).	Produce, &c. Dressed Corn. Quantity.	Produce, &c. Dressed Corn. Weight per Bushel.	Total Corn.	Straw and Chaff.	Total Produce (Corn and Straw).	Corn to 100 Straw.	Increase by Manure. Dressed Corn. Over Unmanured.	Dressed Corn. Over corresponding Mineral Manures.	Total Corn. Over Unmanured.	Total Corn. Over corresponding Mineral Manures.	Total Straw (and Chaff). Over Unmanured.	Total Straw (and Chaff). Over corresponding Mineral Manures.	Total Produce. Over Unmanured.	Total Produce. Over corresponding Mineral Manures.	Plots.
		Bushels.	lbs.	lbs.	Cwts.	lbs.		Bushels.	Bushels	lbs.	lbs.	Cwts.	Cwts.	lbs.	lbs.	
1 O.	Unmanured continuously	20	52·3	1133	11¾	2454	86·6	..	..	..	..	..	..	..	..	1 O.
2 O.	3½ cwts. Superphosphate of Lime (1)	25⅜	53·2	1439	13¼	2931	97·1	4⅜	..	252	..	1⅛	..	389	..	2 O.
3 O.	200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia	22¼	53·0	1268	12⅛	2641	92·4	1⅞	..	80	..	⅛	..	99	..	3 O.
4 O.	200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate	27⅜	53·4	1550	14⅝	3162	96·4	6½	..	363	..	2¼	..	621	..	4 O.
1 A.	200 lbs. Ammonia-salts (4)	32¼	52·1	1840	18½	3919	89·2	11⅜	..	652	..	6¼	..	1376	..	1 A.
2 A.	200 lbs. Ammonia-salts, 3½ cwts. Superphosphate	47	53·5	2662	27⅝	5760	86·8	26	21½	1475	1223	15½	14¼	3217	2829	2 A.
3 A.	200 lbs. Ammonia-salts, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia	35	52·8	1992	20⅞	4317	86·3	14	12⅝	804	724	8¾	8¼	1774	1656	3 A.
4 A.	200 lbs. Ammonia-salts, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate	46¾	54·0	2630	28½	5817	83·2	25¾	18⅞	1443	1080	16⅞	14¼	3275	2655	4 A.
(5) 1 AA.	275 lbs. Nitrate Soda	37	52·0	2091	22¼	4562	85·6	16	..	904	..	10	..	2020	..	1 AA. (5)
(5) 2 AA.	275 lbs. Nitrate Soda, 3½ cwts. Superphosphate	49¾	53·3	2795	30¼	6217	82·8	28¾	23⅞	1608	1356	18½	15¼	3675	3286	2 AA. (5)
(5) 3 AA.	275 lbs. Nitrate Soda, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia	37⅝	52·3	2128	24⅞	4864	78·8	16⅝	15	941	861	12⅞	12⅝	2321	2223	3 AA. (5)
(5) 4 AA.	275 lbs. Nitrate Soda, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate	49⅞	53·4	2813	32⅜	6443	79·5	28⅞	22½	1625	1263	20⅜	18	3901	3281	4 AA. (5)
(5) 1 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda (6)	37	54·3	2093	21⅞	4543	86·3	16	..	1105	..	11⅞	..	2403	..	1 AAS. (5)
(5) 2 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda (6), 3½ cwts. Superphosphate	47¾	55·8	2708	29	5956	85·8	26¾	21⅞	1720	1269	18⅞	15⅞	3816	3025	2 AAS. (5)
(5) 3 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda (6), 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia	43⅞	55·0	2489	25⅞	5382	87·5	22⅞	21¼	1501	1221	15½	13⅝	3242	2711	3 AAS. (5)
(5) 4 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda (6), 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate	50	55·8	2884	31¼	6411	85·2	29	22½	1896	1331	21¼	17⅞	4271	3249	4 AAS. (5)
(7) 1 C.	1000 lbs. Rape-cake	45¾	53·8	2568	26⅞	5571	87·3	24⅛	..	1380	..	14⅜	..	3028	..	1 C. (7)
(7) 2 C.	1000 lbs. Rape-cake, 3½ cwts. Superphosphate	46⅞	53·9	2664	28⅞	5844	85·6	25⅞	21¼	1477	1225	16⅛	15	3302	2913	2 C. (7)
(7) 3 C.	1000 lbs. Rape-cake, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia	42⅞	53·7	2494	27⅛	5527	83·5	22⅞	21¼	1307	1226	15	14⅝	2985	2886	3 C. (7)
(7) 1 C.	1000 lbs. Rape-cake, 200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate	47⅞	53·6	2698	29⅛	6002	83·0	26⅞	19⅝	1510	1148	17⅞	15⅜	3460	2840	4 C. (7)
(8) 1 N.	275 lbs. Nitrate Soda	37⅞	52·7	2116	22⅞	4683	83·7	16⅞	..	950	..	11⅜	..	2191	..	1 N. (8)
(8) 2 N.	275 lbs. Nitrate Soda (550 lbs. Nitrate for 5 years, 1853, 4, 5, 6, and 7)	41⅛	52·7	2336	26⅛	5258	81·0	20⅞	..	1170	..	14½	..	2765	..	2 N. (8)
M.	100 lbs. (9) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate (commencing 1855; 1852, 3, and 4, unmanured)	21⅜	53·2	1217	12⅜	2597	88·7	⅜	..	121	..	1⅛	..	278	..	M.
5 O.	200 lbs. (2) Sulphate Potass, 3½ cwts. Superphosphate (200 lbs. Ammonia-salts also, for the first year, 1852, only)	22⅞	53·4	1293	12⅞	2682	96·2	1¾	..	128	..	⅜	..	190	..	5 O.
5 A.	200 lbs. (2) Sulphate Potass, 3½ cwts. Superphosphate, 200 lbs. Ammonia-salts	44⅛	53·8	2506	28	5641	80·4	23⅛	21⅜	1318	1212	15⅝	15⅜	3102	2962	5 A.
6 1	Unmanured continuously	22	52·5	1242	12⅞	2630	89·6	..	..	..	..	..	..	..	..	1 6
6 2	Ashes (burnt-soil and turf)	21⅞	52·6	1245	12⅜	2603	91·4	⅞	..	58	..	⅜	..	60	..	2 6
7	14 Tons Farmyard Manure	48¼	54·3	2768	28¼	5933	88·5	27¼	20⅞	1580	1218	16⅜	13⅞	3391	2571	7

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—maintain the yield at a slightly higher point than it will reach on the absolutely unmanured land.

TABLE XXV.—Average Annual Produce of Barley without Manure, and with Ashes (burnt soil and turf.)

Plots.		Average Annual Produce. First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.	Second 10 Years over (or under –) First 10.
	Dressed Corn, per Acre—Bushels.				Per Cent.
10	Unmanured continuously	$22\frac{3}{8}$	$17\frac{1}{2}$	20	–21·8
61	Unmanured continuously (duplicate)	25	$18\frac{7}{8}$	22	–24·5
62	20 Bushels ashes	$23\frac{7}{8}$	20	$21\frac{7}{8}$	–16·2
	Total Corn, per Acre—lbs.				
10	Unmanured continuously	1281	985	1133	–23·1
61	Unmanured continuously (duplicate)	1414	1070	1242	–24·3
62	20 Bushels ashes	1352	1138	1245	–15·8
	Straw (and Chaff), per Acre—Cwts.				
10	Unmanured continuously	$13\frac{3}{8}$	$10\frac{1}{4}$	$11\frac{3}{4}$	–23·4
61	Unmanured continuously (duplicate)	14	$10\frac{3}{4}$	$12\frac{3}{8}$	–23·2
62	20 Bushels ashes	13	$11\frac{1}{4}$	$12\frac{1}{8}$	–13·5
	Total Produce (Corn, Straw, and Chaff), per Acre—lbs.				
10	Unmanured continuously	2782	2126	2454	–23·6
61	Unmanured continuously (duplicate)	2987	2273	2630	–23·9
62	20 Bushels ashes	2814	2391	2603	–15·0
	Weight per Bushel of Dressed Corn—lbs.				
10	Unmanured continuously	51·6	53·1	52·3	2·9
61	Unmanured continuously (duplicate)	51·5	53·5	52·5	3·9
62	20 Bushels ashes	51·6	53·6	52·6	3·9
	Corn to 100 Straw.				
10	Unmanured continuously	85·9	87·3	86·6	1·6
61	Unmanured continuously (duplicate)	89·8	89·4	89·6	– 0·4
62	20 Bushels ashes	92·0	90·9	91·4	– 1·2

At any rate, the fact that the plot manured with ashes has, over 20 years, not given any more produce than the immediately adjoining unmanured plot, is a sufficient answer to the objection that the admixture of a much smaller quantity of the same description of ashes with the artificial manures used on the other plots, in any way vitiates the results, or obscures the proper interpretation of them.

The average annual produce of barley on the land in question, without manure, may be taken at about 21 bushels of grain, and 12 cwts. of straw.

It will be of interest to compare the produce of barley without manure with that of wheat in the immediately adjoining field. Table XXVI. (see next page) illustrates the point; and for the sake of easier comparison, the produce of both crops is given in pounds. For wheat the average annual produce is given—for the whole 28 years of the experiments; for the first 20 years, which will, perhaps, best compare with the barley, so far as condition of land at the commencement of the series is concerned; and for the last 20 years, which comprise the same period as that of the barley results, and will, hence, compare best so far as any influence of season is concerned, but which succeeds 8 years of the growth of the crop without manure. For the barley, the mean produce of the two unmanured plots (1 O and 6–1) is given.

It is seen that, over a period of 20 years without manure, the barley has yielded a greater weight of corn, but less of straw, per acre, per annum, than the wheat. This is the case, whether the produce of wheat be averaged over the whole 28, the first 20, or the last 20 years. The average weight of total produce (corn and straw together) is, however, much more nearly the same for both crops. It is almost identical when the comparison is made with the wheat averaged over the whole 28 years; it is in favour of the wheat when the first 20 years of each crop is taken, and in an almost exactly equal degree in favour of the barley when both crops are taken over the same period, namely, the 20 years—1852–'71, which, in the case of the wheat, succeeded the removal of eight previous unmanured crops, but in that of the barley were the first 20 years of its continuous growth.

Prior to the commencement of the experiments the previous cropping had been as under:—

Wheat-Field.	*Barley-Field.*
Turnips (dunged).	Turnips (dung and superphosphate) carted off.
Barley.	Barley.
Peas.	Clover.
Wheat.	Wheat.
Oats.	Barley (sulphate ammonia).

TABLE XXVI.—Average Annual Produce of Wheat, and of Barley, without Manure.

	AVERAGE ANNUAL PRODUCE, &c.				BARLEY MORE (OR LESS−) THAN WHEAT.		
	First Half of Period.	Second Half of Period.	Total Period.	Second Period over (or under−) First Period.	First Half of Period.	Second Half of Period.	Total Period.
Total Corn, per Acre.							
Wheat:—	lbs.	lbs.	lbs.	Per Cent.	lbs.	lbs.	lbs.
28 years, 1844–1871	1053	891	972	−15·4	295	137	216
20 years, 1844–1863	1018	1035	1026	1·7	330	− 7	162
20 years, 1852–1871	944	881	913	− 6·7	404	147	275
Barley:—							
20 years, 1852–1871	1348	1028	1188	−23·7			
Straw (and Chaff), per Acre.							
Wheat:—							
28 years, 1844–1871	1713	1355	1534	−20·9	−176	−183	−180
20 years, 1844–1863	1693	1693	1693	..	−156	−521	−339
20 years, 1852–1871	1663	1241	1451	−25·4	−126	− 69	− 97
Barley:—							
20 years, 1852–1871	1537	1172	1354	−23·7			
Total Produce (Corn, Straw, and Chaff), per Acre.							
Wheat:—							
28 years, 1844–1871	2766	2246	2506	−18·8	119	− 46	36
20 years, 1844–1863	2711	2728	2719	0·6	174	−528	−177
20 years, 1852–1871	2607	2122	2364	−18·6	278	78	178
Barley:—							
20 years, 1852–1871	2885	2200	2542	−23·7			

It is possible, therefore, that there would be rather more *nitrogenous condition* to work out of the barley than out of the wheat land. Consistently with this, the barley gives much more excess of corn, and much less deficiency of straw, compared with the wheat in the earlier years. It also shows much more rapid decline in total produce than the wheat. The evidence leads to the conclusion, therefore, that the wheat will eventually maintain a somewhat higher total produce than the barley. This is what would be expected with the autumn-sown crop, with its longer period for root-development, and consequent possession of a greater range of soil for the collection of food.

It has already been shown that what may be termed, in an agricultural sense, corresponding crops of wheat and barley, require very nearly identical amounts of the different constituents to be available within the soil. These results show, experimentally, how nearly equal are the amounts of *gross produce* of the two crops, which a soil in a given condition will yield; and it seems probable that the only difference will be that which is due to varying adaptation of season, and to the greater or less root-range of the one crop or the other.

Average Annual Produce by Farmyard Manure.

Table XXVII. shows the average annual produce of barley, and the increase over the mean produce without manure, by an annual dressing of 14 tons of farmyard manure per acre.

TABLE XXVII.—Average Annual Produce, and Increase of Barley by Farmyard Manure (Plot 7.)

	AVERAGE ANNUAL PRODUCE, &c.				INCREASE OVER (or under –) UNMANURED (Plots 1 O and 6-1		
	First 10 Years, 1852-'61.	Second 10 Years, 1862-'71.	Total Period, 20 Years, 1852-'71.	Second 10 Years over (or under –) First 10 Years.	First 10 Years, 1852-'61.	Second 10 Years, 1862-'71.	Total Period 20 Yea 1852-'7
				Per Cent.			
Dressed Corn per acre .. .. .. bushels	45	51½	48¼	14·4	21⅜	33⅜	27¼
Total Corn per acre .. .. lbs.	2541	2995	2768	17·9	1193	1967	1580
Straw (and Chaff) per acre .. .. cwts.	26⅝	29⅞	28¼	12·2	12⅞	19⅜	16¼
Total Produce (Corn, Straw, &c.) per acre lbs.	5525	6342	5933	14·8	2640	4141	3391
Weight per Bushel of Dressed Corn lbs.	52·6	56·0	54·3	6·5	1·0	2·7	1·9
Corn to 100 Straw	85·6	91·3	88·5	6·7	–2·3	3·0	0·4

Unlike the produce without manure, that by farmyard manure was, in every particular of quantity, as well as quality, considerably higher over the second than over the first 10 years. Taking the average of the first 10 years, the produce of corn was exceeded by several, and that of straw by more, of the artificial manures; but, over the second 10 years, it was in no case exceeded in average amount of corn, and in only one case in amount of straw. Averaged over the whole period of 20 years, however, several of the mixtures of mineral and nitrogenous manure approached, and some even surpassed, it in produce of corn, more did so in straw, and several in total produce (corn and straw together).

The individual years in which the dunged plot, more or less, exceeded all others, were—in produce of corn, 1859, 1862, 1864, 1865, 1866, 1867, and 1871; in produce of straw, 1862 and

1866; and in total produce, 1859, 1862, 1865, 1866, and 1871. For information as to the characters of season, under the influence of which these results were obtained, we must refer to the description of the respective seasons in Section 1.

Whilst the unmanured land gave an average annual produce of only 21 bushels of dressed corn, and about 12 cwts. of straw, the farmyard manure gave 48¼ bushels of dressed corn, and 28¼ cwts. of straw; or an average increase over the mean unmanured of 27¼ bushels of corn, and 16⅛ cwts. of straw.

During the 20 years, 280 tons of dung, containing from 80 to 90 tons of dry solid matter, have been applied per acre. But the produce has only amounted to about 24¾ tons of corn, and 28¼ tons of straw, or in all to only 53 tons; and the increase, over the produce without manure, has only been about 14⅛ tons of corn, and 16⅛ tons of straw—in all 30¼ tons of total increase; which certainly would contain less than one-third as much dry solid matter as was supplied in the dung. The manure would, in fact, supply to the soil very much more of carbon, of nitrogen, of phosphoric acid, of potass, of lime, of magnesia—indeed, probably of every constituent, than the total produce contained; and, of course, a still greater excess over the amounts taken off in the *increase* of produce.

It is evident that there must be a very great accumulation of constituents in the soil of the dunged plot. Of nitrogen, for example, from 3 to 4 times as much has been applied as to any of the artificially manured plots; and, judging from the determinations of nitrogen in the soil of the dunged plot in the wheat-field, it is probable that the percentage of that substance in the surface-soil of the dunged barley plot has, during the 20 years, been nearly doubled. Yet, mixtures of mineral manure and ammonia-salts, or nitrate of soda, supplying nitrogen in so much less quantity, but in a more readily available condition, frequently gave about the same, and sometimes more, produce than the dung. It is obvious, too, that the large amount of nitrogen accumulated in the soil of the dunged plot is in a far less available or effective condition than the much smaller quantities annually supplied as ammonia-salts or nitrate of soda.

In order to ascertain in what degree the accumulated nitrogen and other constituents will be annually available, and for what length of time any residue will remain effective, the dunged plot has, since the removal of the twentieth crop, been divided into two portions—one to receive dung annually, as before, and the other to be left unmanured, probably until the produce on it approximates to that of the continuously unmanured plot.

The following Table shows the results obtained by the annual application of 14 tons of dung per acre, for barley, and for wheat, respectively. As before, the produce is, for easy comparison, given in pounds, and that of the wheat is averaged over the whole 28, the first 20, and last 20 years.

TABLE XXVIII.—Average Annual Produce of Wheat, and of Barley, by 14 tons Farmyard Manure per Acre, per Annum.

	Average Annual Produce, &c.						
					Barley over (or under −) Wheat.		
	First Half of Period.	Second Half of Period.	Total Period.	Second Period over (or under −) First Period.	First Half of Period.	Second Half of Period.	Total Period.
Total Corn, per Acre.							
Wheat:—	lbs.	lbs.	lbs.	Per Cent.	lbs.	lbs.	lbs.
28 years, 1844–1871	1953	2335	2144	19·6	588	660	624
20 years, 1844–1863	1757	2395	2076	36·3	784	600	692
20 years, 1852–1871	2145	2385	2265	11·2	396	610	503
Barley:—							
20 years, 1852–1871	2541	2995	2768	17·9			
Straw (and Chaff), per Acre.							
Wheat:—							
28 years, 1844–1871	3332	3801	3567	14·1	−348	−454	−402
20 years, 1844–1863	3071	3960	3515	28·9	− 87	−613	−350
20 years, 1852–1871	3795	3803	3799	0·2	−811	−456	−634
Barley:—							
20 years, 1852–1871	2984	3347	3165	12·2			
Total Produce (Corn, Straw, and Chaff), per Acre.							
Wheat:—							
28 years, 1844–1871	5285	6136	5711	16·1	240	206	222
20 years, 1844–1863	4828	6355	5591	31·6	697	− 13	342
20 years, 1852–1871	5940	6188	6064	4·2	−415	154	−131
Barley:—							
20 years, 1852–1871	5525	6342	5933	14·8			

The produce of wheat as well as of barley was considerably higher over the later than over the earlier years; but the rate of increase was very much less over the last 20 than over the first 20 of the total 28 years. It may be mentioned here, in passing, that in only 4 of the 28 years has the produce of wheat-grain been higher on the dunged than on any of the artificially manured plots, namely, in 1855, 1859, 1866, and 1871; and in every year it has been surpassed in weight of straw, and of total produce (corn and straw together), on one or more of the artificially manured plots.

As without manure, so with farmyard manure, over whichever period the wheat is averaged, the barley gives a considerably greater quantity of corn, but considerably less straw, than the wheat. Of total produce, however, when the wheat is averaged over the whole 28 years, the barley gives (over 20 years) an average annual excess of 222 lbs. over the wheat; when the first 20 years of wheat is taken the excess of barley is 342 lbs. per acre per annum; but when both wheat and barley are taken over the same 20 years (in the case of the wheat after 8 preceding years of the same manuring and cropping), the barley gives a slight average annual deficiency of total produce, namely, 131 lbs.*

From these facts it may be concluded that, excepting differences due to season, or other incidental causes, a given amount of farmyard manure annually applied to a given soil will, when averaged over a sufficient period, yield identical amounts of total produce of the autumn-sown and autumn-manured wheat, and of the spring-sown and spring-manured barley.

The practice of applying 14 tons of farmyard manure per acre, per annum, is, it is true, as unusual as that of growing either wheat or barley so many years in succession on the same land. Nevertheless, the results of such an experiment are of much interest. They may be briefly summarised as follows:—With the great accumulation of constituents within the soil, the produce of both crops is higher in the later than in the earlier years; much more corn, but much less straw, was obtained with the spring-sown and spring-manured barley, than with the autumn-sown and autumn-manured wheat; but the two crops gave almost identical amounts of average annual total produce (corn and straw together). Notwithstanding that the dung supplied several times as much nitrogen, and more of all other constituents, its produce seldom exceeded that of some of the artificial mixtures of mineral manure and ammonia-salts, or nitrate of soda.

Lastly in regard to the effects of the farmyard manure, attention has been called (pp. 139–141 and 151) to the influence of the accumulated matter on the physical condition of the soil, increasing its porosity, enabling it to retain more moisture, and rendering the crop much less liable to injury from adverse climatic conditions, and especially from drought. Future experi-

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* The general result is the same whether the acreage *produce* of the two crops be compared, as above, or only the *increase* of produce by manure; and as in adopting the increase as the basis of comparison, the diminution of produce without manure (which moreover was different for the two crops) would be a necessary element affecting the calculation, it is concluded that, for the purpose in view, the comparison of the *produce* of the two crops is less open to objection than that of the *increase*.

ment will show in what degree the accumulated residue from the previous manuring is effective for succeeding crops; and the effects of the different artificial manures now to be considered, will show to what constituents of the dung the increase of produce it has yielded has most probably been mainly due.

Average Annual Produce by purely Mineral Manure.

Under this head attention will chiefly be directed to the results obtained on the plots, and by the manures, as under:—

Plot 2 O—Superphosphate of Lime.

Plot 3 O—"Mixed Alkali-salts"—a mixture of sulphates of Potass, Soda, and Magnesia.

Plot 4 O—"Mixed Mineral Manure"—a mixture of the "Superphosphate of Lime," and the "mixed Alkali-salts."

Table XXIX. shows the average annual produce and increase by these manures. (See next page.)

The first point to remark is that, as without manure and with farmyard manure, so with these purely mineral manures, the weight per bushel of dressed corn is, in each case, considerably higher over the second than over the first 10 years. The proportion of corn to straw is also higher over the later years. This result is doubtless in great measure due to season. Still it is clear that in these points of *quality* there is no deterioration in the crop.

In point of *quantity*, however, the result is very different. There is, with each of the manures, a very considerable falling off in the average annual amount of corn, of straw, and of total produce, over the second as compared with the first 10 years; and rather more where the salts of potass, soda, and magnesia, are used, whether alone or in admixture with superphosphate, than where the superphosphate is used alone. Where the superphosphate and mixed alkali-salts are used together, the greater falling off in the later as compared with the earlier years would seem to be connected with a higher produce by that manure than by the superphosphate alone in the earlier years; whilst, in the later years, the produce by the two manures approximates more closely. Lastly on this point, the average annual increase over the unmanured produce is not, by either manure, widely different over the two periods; but where the superphosphate and the mixed alkali-salts are each used separately, the increase is rather greater, and where they are used together rather less, over the second 10 years—indicating a slightly less rate of decline than without manure with the two former, and a slightly greater decline with the more complete manure—accounted for by its proportionally greater increase over the earlier years.

TABLE XXIX.—Average Annual Produce, and Increase, by purely Mineral Manures.

Plots.	MANURES, PER ANNUM.	AVERAGE ANNUAL PRODUCE, &c.				INCREASE OVER (or under −) UNMANURED (Plots 1 O and 6–1.)		
		First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.	Second 10 Years over (or under −) First 10.	First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.
	Dressed Corn, per Acre—Bushels.							
					Per Cent.			
2 O	Superphosphate ..	28	$23\frac{1}{4}$	$25\frac{5}{8}$	−17·0	$4\frac{1}{4}$	5	$4\frac{5}{8}$
3 O	Mixed Alkali-salts ..	$24\frac{7}{8}$	$20\frac{1}{8}$	$22\frac{1}{2}$	−19·1	$1\frac{1}{8}$	$1\frac{7}{8}$	$1\frac{1}{2}$
4 O	Superphosphate and Mixed Alkali-salts	$30\frac{5}{8}$	$24\frac{1}{2}$	$27\frac{1}{2}$	−20·0	$6\frac{7}{8}$	$6\frac{1}{4}$	$6\frac{1}{2}$
	Total Corn, per Acre—lbs.							
2 O	Superphosphate ..	1562	1317	1439	−15·7	214	289	252
3 O	Mixed Alkali-salts ..	1396	1139	1268	−18·4	48	112	80
4 O	Superphosphate and Mixed Alkali-salts	1712	1387	1550	−19·0	365	360	363
	Straw (and Chaff), per Acre—Cwts.							
2 O	Superphosphate ..	$14\frac{7}{8}$	$11\frac{7}{8}$	$13\frac{3}{8}$	−20·2	$1\frac{1}{8}$	$1\frac{3}{8}$	$1\frac{1}{4}$
3 O	Mixed Alkali-salts ..	$13\frac{7}{8}$	$10\frac{3}{4}$	$12\frac{1}{4}$	−22·5	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{4}$
4 O	Superphosphate and Mixed Alkali-salts	$16\frac{1}{8}$	$12\frac{5}{8}$	$14\frac{3}{8}$	−21·7	$2\frac{3}{8}$	$2\frac{1}{8}$	$2\frac{1}{4}$
	Total Produce (Corn, Straw, and Chaff), per Acre—lbs.							
2 O	Superphosphate ..	3223	2639	2931	−18·1	338	439	389
3 O	Mixed Alkali-salts ..	2944	2338	2641	−20·6	59	138	99
4 O	Superphosphate and Mixed Alkali-salts	3517	2807	3162	−20·2	632	607	621
	Weight per Bushel of Dressed Corn—lbs.							
2 O	Superphosphate ..	52·1	54·4	53·2	4·4	0·6	1·1	0·8
3 O	Mixed Alkali-salts ..	51·8	54·3	53·0	4·8	0·3	1·0	0·6
4 O	Superphosphate and Mixed Alkali-salts	52·3	54·6	53·4	4·4	0·8	1·3	1·0
	Corn to 100 Straw.							
2 O	Superphosphate ..	93·8	100·4	97·1	7·0	5·9	12·0	9·0
3 O	Mixed Alkali-salts	90·0	94·7	92·4	5·2	2·1	6·3	4·3
4 O	Superphosphate and Mixed Alkali-salts	95·1	97·7	96·4	2·7	7·2	9·3	8·3

Over the whole period, the average annual produce by superphosphate of lime alone, is $25\frac{5}{8}$ bushels of dressed corn, and $13\frac{3}{8}$ cwts. of straw; by the mixed alkali-salts alone, $22\frac{1}{2}$ bushels of dressed corn, and $12\frac{1}{4}$ cwts. of straw; and by the two manures together, $27\frac{1}{2}$ bushels of corn, and $14\frac{3}{8}$ cwts. of straw. The unmanured produce being 21 bushels of corn, and 12 cwts. of straw, the average annual increase is, by the superphosphate alone, $4\frac{5}{8}$ bushels of corn, and $1\frac{1}{4}$ cwts. of straw; by the mixed alkali-salts, $1\frac{1}{2}$ bushel of corn, and $\frac{1}{4}$ cwt. of straw; and by the mixture of the two, $6\frac{1}{2}$ bushels of corn, and $2\frac{1}{4}$ cwts. of straw.

Neither of these purely mineral manures has, then, sufficed to yield anything like a fair crop of barley. The mixed alkali-salts alone have given scarcely any increase at all. It was, therefore, not in an available supply of potass, soda, or magnesia, that the soil was rendered relatively deficient, either by the previous ordinary cropping, or by the continuous growth of barley. Superphosphate of lime alone gave but little, though still notably more increase than the mixed alkali-salts. It would appear, therefore, that there was, within the range of the roots, a greater relative deficiency of available phosphoric acid than of available alkalies. The mixture of the two manures, again, gave slightly more increase than either, or than both, used separately.

The explanation of the effects of these mineral manures, and of the great falling off in the produce, not only by them, but without manure, probably is, that in each case the produce has been limited by the supply of available nitrogen accumulated within the soil, whether from previous cultivation, manuring, and cropping, or by annual deposition and absorption; and that, with the increased supplies of available mineral matter near the surface, root-development has been more or less increased, possession thus acquired of a greater range of soil, and, with this, access obtained to more of its stored-up nitrogen. On this view, the "*condition*" of the soil, as distinguished from its normal or natural fertility, is at any rate so far as available nitrogen is concerned, being gradually worked out by the growth of the crop, whether without manure, or with the purely mineral manures; and it remains to be seen whether or not the point of normal annual produce has yet been reached.

There are two other plots receiving annually mineral manure alone; namely 5 O, and M; the full particulars of which will be found in the Appendix Tables. They are much smaller, and at the opposite end of the field from the other mineral-manured plots, and the results seem not altogether comparable with those of the latter, though there is less reason to suppose that they are not so with one another. Plot 5 O has received annually superphosphate of lime and sulphate of potass (that is excluding sulphates of soda and magnesia); and Plot M has received superphosphate, and sulphates of soda and magnesia (that is excluding sulphate of potass).

The mixture of superphosphate and potass-salt has given an annual average of slightly more corn, but no more straw, than the superphosphate and soda and magnesia salts, without potass. The produce by both manures has fallen off over the later as compared with the earlier years, so far as corn is concerned ; but by that including potass it has done so more than by the one without it; and whilst by the manure containing potass, the produce of straw also has fallen off, that by the soda and magnesia without potass has even increased in straw during the later years. Taken over the whole period, the mixture of superphosphate and potass-salt has given annually about $1\frac{1}{2}$ bushel more corn, but only exactly the same amount of straw, as that with soda and magnesia, but without potass. The crop was, however, in both cases most miserable; in the one only $22\frac{7}{8}$, in the other only $21\frac{1}{2}$ bushels of corn, and in both only $12\frac{3}{8}$ cwts. of straw.

It may be concluded that there was in neither case any deficiency of *mineral* matter for such meagre crops; but that in the one the relatively liberal supply of potass favoured seeding tendency, and in the other the salts of soda and magnesia, whether by action on the soil, or more directly on the development of the plant itself, favoured some increase of plant, without corresponding seeding tendency. Evidence of the effects of superphosphate and potass-salts, compared with superphosphate, potass, soda, magnesia-salts will be forthcoming when the results obtained with these mixtures in conjunction with nitrogenous manures are considered.

It will be of interest to compare the effects of purely mineral manures on wheat, and on barley. The following Table (XXX.) shows the effects of the same "mixed mineral manure," used over the same period of 20 years, with the two crops. As in the case of the experiment with farmyard manure, the produce, not the increase, of the two crops is taken for illustration, and, *mutatis mutandis*, for similar reasons. But it should be further explained, that whilst in the case of the wheat plot, 8 crops, variously but upon the whole liberally manured, had already been taken, in that of the barley the period commences with the first year of the experiments.

As without manure, and with farmyard manure, so with the mixed mineral manures, barley yields considerably more grain than wheat—in fact, not far short of one-half more. On the other hand, it gives rather less straw, but of total produce (corn and straw together) considerably more than the wheat. It may be added that, although the figures and their relations would differ, more or less, if the increase instead of the produce were taken for comparison, yet the general results would be the same.

TABLE XXX.—Average Annual Produce of Wheat and of Barley by purely Mineral Manure.

Manures per Acre, per Annum:— 3½ Cwts. Superphosphate of Lime. 200 lbs. (1) Sulphate Potass. 100 lbs. (2) Sulphate Soda. 100 lbs. Sulphate Magnesia.	Average Annual Produce, &c.			
	First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852'–71.	Second 10 Years over (or under –) First 10.
Total Corn, per Acre—lbs.				
				Per Cent.
Wheat (Plot 5) 20 years, 1852–1871	1149	987	1068	–14·1
Barley (Plot 4 O) 20 years, 1852–1871	1712	1387	1550	–19·0
Barley over (or under –) Wheat	563	400	482	
Straw (and Chaff), per Acre—lbs.				
Wheat (Plot 5) 20 years, 1852–1871	1919	1437	1678	–25·1
Barley (Plot 4 O) 20 years, 1852–1871	1805	1420	1612	–21·3
Barley over (or under –) Wheat	–114	–17	–65	
Total Produce (Corn, Straw, and Chaff), per Acre—lbs.				
Wheat (Plot 5) 20 years, 1852–1871	3068	2424	2746	–21·0
Barley (Plot 4 O) 20 years, 1852–1871	3517	2807	3162	–20·2
Barley over (or under –) Wheat	449	383	417	

(1) 300 lbs. for the first 6 years of barley, and first 7 years of wheat.
(2) 200 lbs. for the first 6 years of barley, and first 7 years of wheat.

The result itself is remarkable from several points of view. The wheat plot, although it had previously yielded 8 experimental crops, had, during that time, received considerable quantities of mineral manure and ammonia-salts, and some rape-cake also. It would be supposed, therefore, that there was more "*condition*" to work out of it than out of the barley plot. Then again, the assumed greater root-range of the autumn-sown wheat, than of the spring-sown barley, and the longer period of growth of the autumn-sown crop, would, it might be concluded, give it a greater command over the stores within the soil. Further, calculation shows that the barley crop would actually contain more nitrogen than the wheat.

Is the less result with mineral manures on wheat than on barley due to the dilution and distribution of the autumn-sown manures by the winter rains, and to their having acquired a comparatively insoluble condition, resulting in a less active root-development in the upper, and more highly nitrogenous layers of the soil, when growth commences in the spring? Is there, consequently, a more rapid exhaustion of the accumulated nitrogen within the soil by the barley than by the wheat? Or, does the pipe-draining of the wheat-field render the drainage the more free, and so cause a greater washing out of nitrogenous compounds in the winter; even from the plots where none are artificially applied? It is at any rate consistent with the supposition that there is a more rapid exhaustion of the nitrogen accumulated within the soil, by the barley than by the wheat, when each is grown without nitrogenous manure, that, according to calculation it appears probable that, both without manure, and with purely mineral manure, the barley has carried off more nitrogen from a given area than the wheat, whilst it has, under both conditions, declined more rapidly in annual produce of corn, and without manure in *total* produce also.

The general result with the purely mineral manures is—that superphosphate of lime gave more increase of barley than a mixture of salts of potass, soda, and magnesia; that neither the one nor the other, nor the mixture of all, sufficed to raise the produce to anything like a fair crop; and that, with either, the crop fell off considerably over the later years. Nevertheless, boththe produce and the increase of barley by the mixed mineral manure were considerably greater than those of wheat by the same manure. It may be concluded that the exhaustion which the soil undoubtedly suffered, was not connected with a relative deficiency of any of the constituents which these mineral manures supplied. The results next to be considered will show in what the exhaustion really did consist.

Average Annual Produce by Ammonia-salts alone, or Nitrate of Soda alone.

Of the four experiments under this head, the first to be noticed are those on—

Plot 1 A with 200 lbs. of ammonia-salts per acre per annum, for 20 years, 1852-1871.

Plot 1 N with 275 lbs. nitrate of soda per acre per annum, for 19 years, 1853-1871.

200 lbs. of ammonia salts and 275 lbs. of nitrate of soda, are estimated to supply the same amount of nitrogen, namely 41 lbs. = 50 lbs. of ammonia. But it must be noted that the plot subsequently

having nitrate received, in the first year of the twenty, $3\frac{1}{2}$ cwts. of superphosphate of lime, and 300 lbs. of sulphate of potass, per acre. These mineral manures gave no increase whatever in the year of their application; but, under the exhausting process of afterwards using nitrogenous manures alone for so many years in succession, they have doubtless had considerable effect on the succeeding crops. Hence, unfortunately, the two experiments, the one with a given amount of nitrogen as ammonia-salts for 20 years, and the other with the same amount as nitrate of soda for the last 19 of the 20 years, are not strictly comparable. (Table XXXI. next page.)

In the first place, notwithstanding the great demand made on the mineral resources of the soil, by applying ammonia-salts alone year after year, there is considerably less falling off in the produce over the second as compared with the first ten years, under such treatment, than by the application of mixed mineral manure alone every year. And not only so: whilst, over the twenty years, the average annual produce was, by the mixed mineral manure only $27\frac{1}{2}$ bushels of corn and $14\frac{3}{8}$ cwts. of straw, that by the 200 lbs. of ammonia-salts alone was $32\frac{1}{2}$ bushels of corn, and $18\frac{1}{2}$ cwts. of straw. In other words, whilst the *increase* of produce by the mixed mineral manure alone averaged, over twenty years, only $6\frac{1}{2}$ bushels of corn and $2\frac{1}{4}$ cwts. of straw, per acre per annum, that by this comparatively small quantity of ammonia-salts alone averaged, over the same period, $11\frac{1}{2}$ bushels of corn, and $6\frac{3}{8}$ cwts. of straw.

Comparing the result by ammonia-salts for 20 years, with that by the same quantity of nitrogen as nitrate of soda for 19 years, the average annual produce and increase are $5\frac{1}{4}$ bushels of corn, and $4\frac{5}{8}$ cwts. of straw, more by the nitrate than by the ammonia-salts.

It is obvious that, owing to the greater solubility, and more rapid distribution in the soil and subsoil, of the nitrate or its products of decomposition, it will be the more liable to loss by drainage when there is an excess of rain. On the other hand, as already referred to (p. 140), the subsoil in its case becomes more disintegrated, therefore more porous, more retentive of moisture in a favourable condition, and more permeable by the roots. It is, probably, in part due to this action that the effects of a given amount of nitrogen as nitrate of soda increase from year to year compared with those of an equivalent application as ammonia-salts. How much of the greater effect of the nitrate in the experiment in question may be due to this action, and how much to the supply of mineral manure to the nitrated plot in the first year, it is impossible to determine.

On the latter point it may be mentioned, that the amounts of

TABLE XXXI.—Average Annual Produce and Increase of Barley by 200 lbs. of Ammonia-salts alone, or 275 lbs. of Nitrate of Soda alone.

Plots.	MANURES PER ACRE, PER ANNUM.	AVERAGE ANNUAL PRODUCE, &c.				AVERAGE ANNUAL INCREASE OVER (or under –) UNMANURED (Plots 1 O and C-1.)		
		First Half of Period. (1)	Second Half of Period.	Total Period. (1)	Second Period (over or under –) First Period.	First Half of Period. (1)	Second Half of Period.	Total Period. (1).
	Dressed Corn, per Acre—Bushels.							
					Per Cent.			
1 A	200 lbs. Ammonia-salts; 20 years, 1852–1871 ..	33 5/8	31 3/8	32 1/2	– 6·7	9 7/8	13 1/8	11 1/2
1 N	275 lbs. Nitrate Soda; 19 years, 1853–1871	37 5/8	37 1/8	37 3/8	– 1·3	14 3/8	18 5/8	16 3/4
	Total Corn, per Acre—lbs.							
1 A	200 lbs. Ammonia-salts; 20 years, 1852–1871 ..	1908	1771	1840	– 7·2	560	744	652
1 N	275 lbs. Nitrate Soda; 19 years, 1853–1871	2124	2108	2116	– 0·8	806	1081	950
	Straw (and Chaff), per Acre—Cwts.							
1 A	200 lbs. Ammonia-salts; 20 years, 1852–1871 ..	19 3/4	17 3/8	18 1/2	–12·0	6	6 7/8	6 3/8
1 N	275 lbs. Nitrate Soda; 19 years, 1853–1871	23 3/8	22 1/2	22 7/8	– 3·7	10	11 3/4	10 7/8
	Total Produce (Corn, Straw, and Chaff), per Acre—lbs.							
1 A	200 lbs. Ammonia-salts; 20 years, 1852–1871 ..	4119	3719	3919	– 9·7	1234	1519	1376
1 N	275 lbs. Nitrate Soda; 19 years, 1853–1871	4745	4628	4683	– 2·5	1928	2428	2191
	Weight per Bushel of Dressed Corn—lbs.							
1 A	200 lbs. Ammonia-salts; 20 years, 1852–1871 ..	51·2	53·0	52·1	3·5	–0·3	–0·3	–0·3
1 N	275 lbs. Nitrate Soda; 19 years, 1853–1871	51·6	53·7	52·7	4·1	0·1	0·4	0·3
	Corn to 100 Straw.							
1 A	200 lbs. Ammonia-salts; 20 years, 1852–1871 ..	86·4	91·9	89·2	6·4	–1·5	3·5	1·1
1 N	275 lbs. Nitrate Soda; 19 years, 1853–1871	81·3	86·0	83·7	5·8	–6·9	–2·4	–4·5

(1) For the Nitrate plot (1 N), the averages for the first period are for only 9 years, and for the total period for only 19 years.

phosphoric acid and potass applied in the first year, but which gave no increase in that year, were sufficient, if still present and available, to supply those constituents for more than the excess of corn and straw obtained on the nitrate, as compared with the ammonia-plot. Further, the experiments with wheat have afforded abundant evidence, that phosphates and potass-salts previously applied, have been effective for 20 years or more, when nitrogenous manures have been afterwards supplied, to work them out, so to speak. There can be little doubt, indeed, that part, at any rate, of the greater effect of the nitrate in the experiment in question, was really due to the supply of mineral constituents in the first year.

The results next to be considered show the effects of double the above amounts of ammonia-salts alone, or nitrate of soda alone, but applied for a few years only as under:—

Plot 1. A. A :—

6 years, 1852-1857, 400 lbs. ammonia-salts, per acre, per annum.

Plot 2. N :—

1 year, 1852, $3\frac{1}{2}$ cwts. superphosphate, 300 lbs. sulphate potass;

5 years, 1853-1857, 550 lbs. nitrate of soda.

Thus, as in the previous comparison, the two plots received corresponding amounts of nitrogen as ammonia-salts, and as nitrate of soda, respectively, for a series of years; but whilst the ammonia plot received the double dressing of ammonia-salts, in the first as well as the succeeding 5 years, the nitrate plot received phosphates and potass without nitrate in the first year, and the double quantity of nitrate in the succeeding 5 years.

Table XXXII. (See next page) shows the produce obtained, and also the increase, both over the unmanured produce, and over that by the smaller amounts of ammonia-salts, or nitrate, in the corresponding years.

Thus, there is an average annual produce of 46 bushels of corn, and $28\frac{1}{2}$ cwts. of straw, by the application of 400 lbs. of ammonia-salts alone for 6 years; also of 48 bushels of corn, and $31\frac{1}{2}$ cwts. of straw, by the same amount of nitrogen as nitrate of soda alone for 5 years (but succeeding a dressing of superphosphate and sulphate of potass). The produce by the double amount of ammonia-salts alone represents an average annual increase over the unmanured produce of $17\frac{7}{8}$ bushels of corn, and $12\frac{1}{4}$ cwts. of straw; and of $7\frac{3}{8}$ bushels of corn, and $5\frac{7}{8}$ cwts. of straw over that by half the quantity of ammonia-salts for the same period. In like manner the produce by the double amount of nitrate of soda alone, represents an annual total increase of $19\frac{7}{8}$

bushels of corn, and $15\frac{3}{8}$ cwts. of straw; and an increase over the produce by the single amount of nitrate, of $5\frac{7}{8}$ bushels of corn, and 6 cwts. of straw.

TABLE XXXII.—Average Annual Produce and Increase by 400 lbs. Ammonia-salts alone, or 550 lbs. Nitrate of Soda alone.

Plots.	MANURES PER ACRE, PER ANNUM.	Average Annual Produce.	Average Annual Increase. Over Unmanured (Plots 1 0 and 6-1.)	Average Annual Increase. 1 AA over 1 A. / 2 N over 1 N.
	Dressed Corn per Acre—Bushels.			
1 AA	400 lbs Ammonia-salts; 6 years, 1852–1857	46	$17\frac{7}{8}$	$7\frac{3}{8}$
2 N	550 lbs. Nitrate of Soda; 5 years, 1853–1857	48	$19\frac{7}{8}$	$5\frac{7}{8}$
	Total Corn per Acre—lbs.			
1 AA	400 lbs. Ammonia-salts; 6 years, 1852–1857	2603	1005	412
2 N	550 lbs. Nitrate of Soda; 5 years, 1853–1857	2666	1070	302
	Straw (and Chaff) per Acre—Cwts.			
1 AA	400 lbs. Ammonia-salts; 6 years, 1852–1857	$28\frac{1}{2}$	$12\frac{1}{4}$	$5\frac{7}{8}$
2 N	550 lbs. Nitrate of Soda; 5 years, 1853–1857	$31\frac{1}{2}$	$15\frac{3}{8}$	6
	Total Produce (Corn, Straw, and Chaff) per Acre—lbs.			
1 AA	400 lbs. Ammonia-salts; 6 years, 1852–1857	5794	2371	1066
2 N	550 lbs. Nitrate of Soda; 5 years, 1853–1857	6198	2794	972
	Weight per Bushel of Dressed Corn—lbs.			
1 AA	400 lbs. Ammonia-salts; 6 years, 1852–1857	50·7	− 1·0	−0·8
2 N	550 lbs. Nitrate of Soda; 5 years, 1853–1857	50·9	− 0·7	−1·0
	Corn to 100 Straw.			
1 AA	400 lbs. Ammonia-salts; 6 years, 1852–1857	82·5	− 5·7	−4·4
2 N	550 lbs. Nitrate of Soda; 5 years, 1853–1857	75·4	−13·4	−7·4

We have here, then, by the application of ammonia-salts alone, or of nitrate of soda alone, an average annual produce, over 5 or

6 consecutive years, of 46 or 48 bushels of barley; or considerably more than the amount assumed (p. 93) to be a good produce under ordinary rotation and cultivation. These amounts are also fully one-third more than was obtained by purely mineral manure over the same period.

It was found that these double dressings were too heavy, the crops frequently being much laid; and hence, after the first 6 years of the experiments, the quantities were reduced to one-half, that is, to the same as on plots 1 A and 1 N. For many subsequent years, however, the plots previously receiving the larger amounts, whether alone, or with mineral manure (as presently to be noticed), continued to yield more produce than the plots receiving the smaller quantity from the commencement. But as the effects of the unexhausted residue from previous manuring upon succeeding crops will be considered separately and in detail in Section IV. no more need be said on the point in this place.

It would be interesting to compare the effects of purely nitrogenous manures on wheat and on barley; but as the experiments with such manures on the two crops are not as parallel as is desirable, either as regards the previous history of the plots, the quantities applied, or the periods and duration of the experiments, the comparison might be misleading unless given with much explanation and qualification. The omission is, however, of the less consequence, as we shall be enabled to compare the effects on the two crops of a mixture of ammonia-salts and mineral manure together, which in fact is of much greater practical importance.

The practice of growing barley for so many years in succession on the same land by any means whatever, is not, it is true, recommended for adoption in practical agriculture; and still less desirable would it be so to grow it by means of ammonia-salts alone, or nitrate of soda alone. But the extraordinary results which have been recorded are not the less instructive and important, or of less practical value, on that account.

It is of no little interest to know, that on a soil, consisting of a somewhat heavy loam with a clayey subsoil, and of only moderate corn-yielding capabilities, purely mineral manures will not yield anything like a fair crop of wheat or barley; but that, on the same soil, a comparatively small quantity of purely nitrogenous manures has yielded, for twenty years in succession, not much less barley than the average crop of the country; and that a larger amount has given, over 6 consecutive seasons, considerably more than an average crop. This is knowledge acquired of the available mineral resources of such a soil, which analysis would not have afforded; and which supplies, if not examples for exact imitation, at any rate a very sound basis for deduction in regard to actual practice.

Average annual Produce by Ammonia-salts or Nitrate of Soda, with mineral Manure in addition.

The first set of experiments to be noticed here, includes four plots, each of which has received 200 lbs. ammonia-salts per acre per annum, throughout the twenty years, but each with a different mineral manure in addition. The mineral manures, here used in admixture with nitrogenous manures, are the same as in the experiments with purely mineral manures, which have already been considered. As only much abbreviated descriptions of the manures can be given in the Table (see next page), they are described in full below :—

Plot 2 A—200 lbs. Ammonia-salts, and 3½ cwts. Superphosphate of Lime.

Plot 3 A—200 lbs. Ammonia-salts, and mixed Alkali-salts, —namely, a mixture of 200 lbs.* Sulphate Potass, 100 lbs.† Sulphate Soda, 100 lbs. Sulphate Magnesia.

Plot 4 A—200 lbs. Ammonia-salts, 3½ cwts. Superphosphate, and the "mixed Alkali-salts."

Plot 5 A—200 lbs. Ammonia-salts, 3½ cwts. Superphosphate, and 200 lbs.* Sulphate Potass.

The produce is averaged over the first 10, the second 10, and the 20 years. The increase is calculated over the produce without manure, and also, in each case, over that by the corresponding mineral manure without ammonia-salts ;—that is 2 A over 2 O, 3 A over 3 O, 4 A over 4 O, and 5 A over 5 O.

It is remarkable that, instead of, as without manure, with purely mineral manure, or with purely nitrogenous manure, a considerable falling off in the second compared with the first half of the total period, there is, with ammonia-salts and mineral manure together (though without silica), in each case a more or less increased produce of corn over the second compared with the first 10 years. On the other hand, there is in two out of the four cases a slight, and in a third a more considerable, deficiency of straw over the later period ; and it is only in that one instance that there is any material diminution in quantity of total produce, and then little more than 5 per cent.

So far as quality of the produce is concerned, both weight per bushel of dressed corn, and proportion of corn to straw, are in every case higher over the second than the first 10 years.

It has been concluded (p. 162) that the second period was, so far as the seasons themselves are concerned, the more favourable for the production of corn, but the less for that of straw and total produce.

* 300 lbs. the first six years, 200 lbs. afterwards.

† 200 lbs. the first six years, 100 lbs. afterwards.

TABLE XXXIII.—Average Annual Produce and Increase by 200 lbs. Ammonia-salts, and Mineral Manure.

Twenty years, 1852–1871.

Plots.	MANURES PER ACRE, PER ANNUM. 200 lbs. Ammonia-salts, and Mineral Manures as under—	AVERAGE ANNUAL PRODUCE, &c. First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total 20 Years, 1852–'71.	Second 10 Years over (or under −) First 10.	AVERAGE ANNUAL INCREASE, 20 YEARS. Over Mean Unmanured.	Over corresponding Mineral Manures.
	Dressed Corn per Acre—Bushels.						
					Per Cent.		
2 A	Superphosphate ..	45¾	48½	47⅛	6·0	26⅛	21½
3 A	Mixed Alkali-salts ..	35	35⅛	35⅛	0·4	14⅛	12⅝
4 A	Superphosphate and Mixed Alkali-salts	46¼	46½	46⅜	0·5	25⅜	18⅞
5 A	Superphosphate and Sulphate Potass ..	43½	44⅞	44⅛	3·2	23⅛	21¼
	Total Corn per Acre—lbs.						
2 A	Superphosphate ..	2563	2762	2662	7·8	1474	1223
3 A	Mixed Alkali-salts ..	1989	1995	1992	0·3	804	724
4 A	Superphosphate and Mixed Alkali-salts	2593	2668	2630	2·9	1442	1080
5 A	Superphosphate and Sulphate Potass ..	2426	2584	2505	6·5	1317	1212
	Straw (and Chaff) per Acre—Cwts.						
2 A	Superphosphate ..	27⅞	27½	27⅝	−1·5	15½	14¼
3 A	Mixed Alkali-salts ..	21⅞	19¾	20¾	−9·8	8⅝	8½
4 A	Superphosphate and Mixed Alkali-salts	28⅞	28	28½	−2·9	16⅜	14⅛
5 A	Superphosphate and Sulphate Potass ..	27⅞	28¼	28	1·5	15⅞	15⅝
	Total Produce (Corn, Straw, and Chaff) per Acre—lbs.						
2 A	Superphosphate ..	5683	5837	5760	2·7	3218	2829
3 A	Mixed Alkali-salts ..	4434	4200	4317	−5·3	1775	1676
4 A	Superphosphate and Mixed Alkali-salts	5827	5808	5817	−0·3	3275	2655
5 A	Superphosphate and Sulphate Potass ..	5542	5747	5644	3·7	3102	2962
	Weight per Bushel of Dressed Corn—lbs.						
2 A	Superphosphate ..	51·8	55·1	53·5	6·4	1·1	0·3
3 A	Mixed Alkali-salts ..	51·5	54·1	52·8	5·0	0·4	−0·2
4 A	Superphosphate and Mixed Alkali-salts	52·2	55·7	54·0	6·7	1·6	0·6
5 A	Superphosphate and Sulphate Potass ..	51·9	55·7	53·8	7·3	1·4	0·3
	Corn to 100 Straw.						
2 A	Superphosphate ..	81·9	91·8	86·8	12·1	−1·3	−10·3
3 A	Mixed Alkali-salts ..	81·4	91·3	86·3	12·2	−1·8	− 6·1
4 A	Superphosphate and Mixed Alkali-salts	79·9	86·4	83·2	8·1	−4·9	−13·2
5 A	Superphosphate and Sulphate Potass ..	77·8	83·1	80·4	6·8	−7·7	−15·8

The evidence taken as a whole, therefore, gives no indication of any deterioration in either the quantity or the quality of the produce as the result of the continuous growth of the crop, provided the necessary constituents are supplied by manure.

It is seen that whilst the average annual produce over the twenty years is, with ammonia-salts and superphosphate of lime $47\frac{1}{8}$ bushels of dressed corn and $27\frac{5}{8}$ cwts. of straw, with the same quantity of ammonia-salts and a mixture of sulphates of potass, soda, and magnesia, it is only $35\frac{1}{8}$ bushels of corn, and only $20\frac{3}{4}$ cwts. of straw. Even with the ammonia-salts and both the superphosphate and the "mixed alkali-salts," it is only $46\frac{3}{8}$ bushels of corn, and $28\frac{1}{2}$ cwts. of straw; or rather less corn, though rather more straw, and total produce, than with the ammonia-salts and superphosphate without the salts of potass, soda, and magnesia. It is further remarkable that the yield of corn has increased more over the later period where the superphosphate was used without, than where in conjunction with the mixed alkali-salts. The details show, however, that the produce, at any rate of straw, where the mixed alkali-salts and the superphosphate are used together, has been of late years somewhat gaining upon that where the superphosphate is used alone.

It may be mentioned, though not shown in the Table, that the *increase* over the unmanured, or over the corresponding mineral manured produce, is much greater over the second period compared with the first, than is the augmentation of the *actual produce* itself. This is explained by the fact that the produce without manure, or by the mineral manures alone, was much the less over the later period, and hence, though there was much the same actual amount of produce over the two periods when ammonia was also used, still the increase over that without ammonia is much the greater.

Over the whole period of twenty years the average annual increase of produce due to the combined action of mineral and nitrogenous manures is, with the ammonia-salts and superphosphate, $26\frac{1}{8}$ bushels of corn and $15\frac{1}{2}$ cwts. of straw; with the same and the mixed alkali-salts in addition, $25\frac{3}{8}$ bushels of corn and $16\frac{3}{8}$ cwts. of straw; with the same and sulphate of potass (without soda and magnesia) $23\frac{1}{8}$ bushels of corn, and $15\frac{7}{8}$ cwts. of straw; but with the ammonia-salts and salts of potass, soda and magnesia (without superphosphate) only $14\frac{1}{8}$ bushels of corn and $8\frac{5}{8}$ cwts. of straw. Or, if the increase be reckoned over the produce by the corresponding mineral manure without ammonia, in which case it is the increase due to the ammonia itself that is more nearly represented, it is, when used with superphosphate of lime $21\frac{1}{2}$ bushels of corn, and $14\frac{1}{4}$ cwts. of straw; when with superphosphate and the mixed alkali-salts $18\frac{7}{8}$ bushels of corn, and $14\frac{1}{8}$ cwts. of straw; when with the superphosphate and sulphate of potass $21\frac{1}{4}$ bushels of corn, and $15\frac{5}{8}$ cwts. of straw; but when with the mixed alkali-salts without superphosphate, only $12\frac{5}{8}$ bushels of corn and $8\frac{1}{2}$ cwts. of straw.

Thus, the effect of a given amount of ammonia is seen to differ very greatly according to the character of the mineral constituents supplied with it. The results clearly show, what common experience also teaches, how effective a manure for barley is superphosphate of lime, provided only there be also a sufficient available supply of nitrogen within the soil. It is, however, as a rule, much less effective with winter-sown than with spring-sown corn-crops; the latter, with their short period of growth, and relatively greater dependence on root-development near the surface, requiring more liberal supplies within a limited range of soil.

Considering the characters of the soil, and the results obtained with other crops, to say nothing of general practical experience, it is only what would be anticipated, that the addition to the ammonia-salts of superphosphate of lime would be much more effective than that of salts of potass, soda, and magnesia; but it is hardly what would be expected that, over twenty years in succession, the soil would yield an average of even rather more corn, only $\frac{7}{8}$ cwt. less straw, and only 57 lbs. less total produce, with ammonia-salts and superphosphate, than with the ammonia-salts, superphosphate, and the mixed alkali-salts together. The illustration is a striking one of the potass-yielding capabilities of such a soil. As already intimated, there are symptoms of a slight change during the last few years; but the fact is of great practical and scientific interest, that by ammonia-salts and superphosphate of lime, without potass or other bases, considerably more than the average barley crop of the country has been obtained for twenty years in succession.

Table XXXIV. shows the produce and increase obtained by the same mineral manures as those employed in three of the four experiments last considered, but, in each case, with double the amount of ammonia-salts; namely, 400 lbs. per acre per annum, used, however, for only the first six years of the twenty. The increase is given over the produce without manure, over that by the corresponding mineral manures without ammonia, and over that by the corresponding mineral manure with only 200 lbs. of ammonia-salts. (Table XXXIV. next page.)

It is obvious that, with an average annual produce of 46 or 47 bushels of barley, over twenty years, by the mineral manures and 200 lbs. of ammonia-salts per acre, the limit of the ripening capabilities of the seasons must have been nearly reached.

TABLE XXXIV.—Average Annual Produce and Increase by 400 lbs. Ammonia-salts, and Mineral Manure.

Six Years, 1852–1857.

Plots.	MANURES PER ACRE, PER ANNUM. 400 lbs. Ammonia-salts, and Mineral Manures as under.	Average Annual Produce. 6 Years, 1852–'57.	AVERAGE ANNUAL INCREASE, 6 YEARS. Over Mean Unmanured.	Over corresponding Mineral Manures.	Over corresponding Mineral Manures and 200 lbs. Ammonia-salts.
	Dressed Corn per Acre—Bushels.				
2 AA	Superphosphate of Lime	$49\frac{5}{8}$	$21\frac{1}{2}$	18	$4\frac{1}{8}$
3 AA	Mixed Alkali-salts	$42\frac{7}{8}$	$14\frac{3}{4}$	14	$3\frac{1}{4}$
4 AA	Superphos. and Mixed Alkali-salts	$50\frac{3}{4}$	$22\frac{5}{8}$	$16\frac{1}{4}$	$4\frac{1}{2}$
	Total Corn per Acre—lbs.				
2 AA	Superphosphate of Lime	2775	1177	1027	230
3 AA	Mixed Alkali-salts	2441	843	814	169
4 AA	Superphos. and Mixed Alkali-salts	2801	1203	887	205
	Straw (and Chaff) per Acre—Cwts.				
2 AA	Superphosphate of Lime	34	$17\frac{3}{4}$	$17\frac{1}{2}$	$5\frac{5}{8}$
3 AA	Mixed Alkali-salts	$29\frac{5}{8}$	$13\frac{3}{8}$	$13\frac{5}{8}$	$4\frac{3}{4}$
4 AA	Superphos. and Mixed Alkali-salts	$36\frac{3}{8}$	$20\frac{1}{8}$	$18\frac{3}{8}$	$7\frac{1}{4}$
	Total Produce (Corn, Straw, and Chaff) per Acre—lbs.				
2 AA	Superphosphate of Lime	6590	3170	2996	872
3 AA	Mixed Alkali-salts	5753	2333	2330	697
4 AA	Superphos. and Mixed Alkali-salts	6874	3454	2948	1011
	Weight per Bushel of Dressed Corn—lbs.				
2 AA	Superphosphate of Lime	50·5	− 1·2	− 1·3	−1·0
3 AA	Mixed Alkali-salts	50·8	− 0·9	− 1·2	−1·0
4 AA	Superphos. and Mixed Alkali-salts	50·4	− 1·3	− 1·5	−1·6
	Corn to 100 Straw.				
2 AA	Superphosphate of Lime	73·1	−15·1	−21·8	−6·9
3 AA	Mixed Alkali-salts	74·1	−14·1	−16·9	−8·0
4 AA	Superphos. and Mixed Alkali-salts	69·4	−18·8	−26·5	−9·9

Indeed, the double amount of ammonia-salts was found, even when used in conjunction with mineral manure, to be quite excessive, the crops being generally laid; and hence, after six years' trial, the extra application was discontinued. Under these circumstances any great increase of produce by 400 lbs. compared with 200 lbs. of ammonia-salts could not be expected. Still, as the last column of the Table shows, the second increment of 200 lbs. did, under favourable conditions of mineral manuring, raise the produce by more than 4 bushels of grain, and by from $5\frac{1}{2}$ to $7\frac{1}{4}$ cwts. of straw; bringing it up, with superphosphate of lime, to $49\frac{5}{8}$ bushels of corn, and 34 cwts. of straw; and with superphosphate and the "mixed alkali-salts" together, to $50\frac{3}{4}$ bushels of corn, and $36\frac{3}{8}$ cwts. of straw.

There is proportionally much more increase of straw than of corn, especially when both the superphosphate and mixed alkali-salts were used. There is also a lower weight per bushel of dressed corn, and a much lower proportion of corn to straw, than with the corresponding mineral manures, either alone, or with the smaller quantity of ammonia-salts. It is clear, therefore, that the extra quantity of ammonia-salts considerably increased the luxuriance; but that the amount of plant produced was more than could, under the conditions of the seasons, form a fair proportion of corn, and ripen well.

Although the second increment of 200 lbs. of ammonia-salts, has thus not yielded anything like the same amount of increase as the first, in the seasons of the application, it will afterwards be seen (Section IV.) that there was a considerable residue of nitrogen left within the soil, which remained available for future crops through many succeeding seasons.

After the six years of the double application, the amount of ammonia-salts was reduced to 200 lbs. per acre per annum, and the experiment continued for ten consecutive seasons. From that time, however, an amount of nitrate of soda (275 lbs.) containing the same amount of nitrogen as 200 lbs. of ammonia-salts, was substituted for the latter; and the results obtained during the four years of the experiment which have so far elapsed, are given in Table XXXV.

It is remarkable that the average produce is almost identical by the nitrate alone, and by the nitrate and "mixed alkali-salts" together. Though much higher, it is again almost identical by the nitrate and superphosphate, and by the nitrate, superphosphate, and "mixed alkali-salts." The little effect, hitherto, of the potass, soda, and magnesia-salts is here again illustrated. The last column shows that, over the four seasons in question, the nitrate gave, under each of the conditions of mineral manuring, both more corn and more straw than the corresponding amount of ammonia-salts. In what degree, however, this difference should be attributed to a greater effect of the nitrate, and in what to a still effective residue from the excessive supply of ammonia-salts

TABLE XXXV.—Average Annual Produce and Increase by 275 lbs. Nitrate of Soda per Acre per Annum, alone, and with Mineral Manures.

Four Years, 1868–1871.

Plots.	MANURES PER ACRE, PER ANNUM. 275 lbs. Nitrate of Soda, without Mineral Manure, and with Mineral Manures as under.	Average Annual Produce. 4 Years, 1868–'71.	AVERAGE ANNUAL INCREASE.		
			Over Mean Unmanured.	Over corresponding Mineral Manures.	Over corresponding Mineral Manures, and 200 lbs. Ammonia-salts.
	Dressed Corn per Acre—Bushels.				
1 AA	Without Mineral Manure	32	$16\frac{1}{4}$	$16\frac{5}{8}$	$3\frac{7}{8}$
2 AA	Superphosphate of Lime	$46\frac{1}{4}$	$30\frac{1}{2}$	$26\frac{3}{4}$	$3\frac{1}{8}$
3 AA	"Mixed Alkali-salts"	$32\frac{1}{2}$	$16\frac{3}{4}$	$15\frac{1}{8}$	$\frac{1}{4}$
4 AA	Superphos. and Mixed Alkali-salts	$46\frac{1}{2}$	$30\frac{3}{4}$	$25\frac{5}{8}$	$4\frac{3}{8}$
	Total Corn per Acre—lbs.				
1 AA	Without Mineral Manure	1788	903	929	187
2 AA	Superphosphate of Lime	2691	1806	1577	187
3 AA	"Mixed Alkali-salts"	1852	967	858	11
4 AA	Superphos. and Mixed Alkali-salts	2692	1807	1498	244
	Straw (and Chaff) per Acre—Cwts.				
1 AA	Without Mineral Manure	$20\frac{1}{8}$	$9\frac{7}{8}$	10	$3\frac{5}{8}$
2 AA	Superphosphate of Lime	$28\frac{1}{8}$	$17\frac{7}{8}$	$18\frac{1}{8}$	$3\frac{3}{4}$
3 AA	"Mixed Alkali-salts"	$21\frac{1}{4}$	11	$11\frac{3}{8}$	$2\frac{1}{4}$
4 AA	Superphos. and Mixed Alkali-salts	$28\frac{5}{8}$	$18\frac{3}{8}$	17	2
	Total Produce (Corn, Straw, and Chaff) per Acre—lbs.				
1 AA	Without Mineral Manure	4047	2023	2061	596
2 AA	Superphosphate of Lime	5843	3819	3611	614
3 AA	"Mixed Alkali-salts"	4238	2214	2142	268
4 AA	Superphos. and Mixed Alkali-salts	5901	3877	3411	475
	Weight per Bushel of Dressed Corn—lbs.				
1 AA	Without Mineral Manure	53·9	0·1	0·3	−0·1
2 AA	Superphosphate of Lime	56·4	2·6	1·5	0·5
3 AA	"Mixed Alkali-salts"	54·4	0·6	−0·6	−0·8
4 AA	Superphos. and Mixed Alkali-salts	56·6	2·8	1·3	−0·1
	Corn to 100 Straw.				
1 AA	Without Mineral Manure	80·6	0·8	1·6	−7·7
2 AA	Superphosphate of Lime	87·9	8·1	−12·5	−7·4
3 AA	"Mixed Alkali-salts"	78·4	−1·4	−11·9	−9·6
4 AA	Superphos. and Mixed Alkali-salts	89·5	9·7	− 3·1	4·5

during the first 6 years, it is not possible to determine. Further comments on the results at present would, therefore, be premature.

It will be more instructive to compare the results obtained by the mixture of mineral and nitrogenous manure on wheat and on barley respectively. The first comparison will be between the effects of the same amounts of superphosphate of lime, and sulphates of potass, soda, and magnesia, and 200 lbs. of ammonia per acre per annum, for 20 consecutive seasons, with each crop. Table XXXVI. shows the result; and as in other cases the produce per acre, and not the increase, is taken for illustration.

TABLE XXXVI.—Average Annual Produce of Wheat and of Barley by Mixed Mineral Manure, and 200 lbs. Ammonia-salts per Acre per Annum.

MANURES PER ACRE, PER ANNUM:— 3½ cwts. Superphosphate of Lime. 200 lbs. (1) Sulphate of Potass. 100 lbs. (2) Sulphate of Soda. 100 lbs. Sulphate of Magnesia. 200 lbs. Ammonia-salts.	AVERAGE ANNUAL PRODUCE, &c. First 10 Years, 1852–'61.	Second 10 Years, 1862–'71.	Total Period, 20 Years, 1852–'71.	Second 10 Years over (or under –) First 10.
Total Corn, per Acre.				
	lbs.	lbs.	lbs.	Per Cent.
Wheat (Plot 6), 20 years, 1852–1871	1697	1639	1668	– 3·4
Barley (Plot 4 A), 20 years, 1852–1871	2593	2668	2630	2·9
Barley over (or under –) wheat	896	1029	962	
Straw (and Chaff), per Acre.				
Wheat (Plot 6), 20 years, 1852–1871	2946	2554	2750	–13·3
Barley (Plot 4 A), 20 years, 1852–1871	3234	3139	3187	– 2·9
Barley over (or under –) wheat	288	585	437	
Total Produce (Corn, Straw, and Chaff), per Acre.				
Wheat (Plot 6), 20 years, 1852–1871	4643	4193	4418	– 9·7
Barley (Plot 4 A), 20 years, 1852–1871	5827	5808	5817	– 0·3
Barley over (or under –) wheat	1184	1615	1399	

(1) 300 lbs. the first 7 years of wheat, and 6 years of barley; 200 lbs. afterwards.
(2) 200 lbs. the first 7 years of wheat, and 6 years of barley; 100 lbs. afterwards.

For the period of 20 years included in the comparison, the manuring was, with a quite immaterial exception explained in the foot-notes, identical for the two crops. But whilst in the case of the barley, the period commences with the first year of the experiments, in that of the wheat 8 experimental crops had already been taken. During that period, however, large quantities of superphosphate of lime, and potass, soda, and magnesia-salts had been applied, as well as liberal dressings of ammonia-salts. It would hardly be concluded, therefore, that the plot had suffered in wheat-growing condition by its previous treatment. Still, though the quantity of wheat-grain averages nearly the same over the two periods, that of the straw and total produce falls off considerably during the latter half of the 20 years. On the other hand, with the barley the quantity of corn is slightly higher, that of straw slightly lower, and that of total produce almost identical, over the two halves of the total period.

It is possible, therefore, that the previous history of the plots may be somewhat to the detriment of the results with wheat; but it is not probable that it has had much adverse influence.

Taking the results as they stand, the barley gives, with exactly the same manure over 20 years, an average annual produce of more than one-half more corn, more than one-sixth more straw, and about 1400 lbs. more total produce (corn and straw together) than the wheat. If, instead of the acreage produce, the increase over that by the same mineral manures without ammonia be taken, the general result is the same; namely, a great deficiency of corn, of straw, and of total produce, of wheat compared with barley, by the same manuring. How is this to be explained?

In reference to this point attention may here be recalled to the facts—that whilst the wheat is autumn-sown and autumn-manured, the barley is both spring-sown and spring-manured; and that when ammonia-salts are sown in the autumn, the winter drainage carries with it large amounts of the nitrogen of the ammonia-salts in the form of nitrates. The probable extent of the loss that may thus arise, will be considered in Section IV. It must suffice here, therefore, to state in general terms that existing evidence leads to the conclusion that it may be very considerable.

The difference of result obtained with wheat and with barley is again illustrated, under somewhat different conditions, in Table XXXVII. (see next page). The comparison is between the effects of the "mixed mineral manure" and 400 lbs. of ammonia-salts, annually applied to the two crops. For wheat the produce is averaged over 20 years (1852-'71) of the treatment, and also over the first 6 years only, those being the seasons in which the same experiment was made with the barley.

In all previous comparisons between wheat and barley the quantity of *produce per acre* has been taken, and not the *increase* of produce over that without manure, or, as the case may be, the increase by mineral manure and ammonia-salts over that by mineral manure without ammonia. It has, however, been remarked that, although the figures would be different, the general result would be the same, whether produce or increase were compared. It would not be so in the case of the experiments now under consideration. Hence, the Table has been arranged to show the comparison, both between the produce per acre, and the increase of produce by the mineral manure and 400 lbs. of ammonia-salts, over that by the corresponding mineral manure alone.

TABLE XXXVII.—Average Annual Produce and Increase of Wheat and of Barley by Mixed Mineral Manure, and 400 lbs. Ammonia-salts per Acre per Annum.

MANURES PER ACRE, PER ANNUM:— 3½ Cwts. Superphosphate of Lime. 300 lbs. (1) Sulphate of Potass. 200 lbs. (2) Sulphate of Soda. 100 lbs. Sulphate of Magnesia. 400 lbs. Ammonia-salts.	Average Annual Produce per Acre.		Mineral Manure and Ammonia-salts over Mineral alone.	Barley over (or under −) Wheat.	
	Mineral Manure and 400 lbs. Ammonia-salts.	Mineral Manure alone.		Produce.	Increase.
Total Corn, per Acre.					
	lbs.	lbs.	lbs.	lbs.	lbs.
Wheat (Plot 7), 20 years, 1852–1871 ..	2228	1068	1160		
Wheat (Plot 7), 6 years, 1852–1857 ..	2195	1171	1024	606	−137
Barley (Plot 4 AA), 6 years, 1852–1857	2801	1914	887		
Straw (and Chaff), per Acre.					
Wheat (Plot 7), 20 years, 1852–1871 ..	3959	1678	2281		
Wheat (Plot 7), 6 years, 1852–1857 ..	4233	2012	2221	−160	−160
Barley (Plot 4 AA), 6 years, 1852–1857	4073	2012	2061		
Total Produce (Corn, Straw, and Chaff), per Acre.					
Wheat (Plot 7), 20 years, 1852–1871 ..	6187	2746	3441		
Wheat (Plot 7), 6 years, 1852–1857 ..	6428	3183	3245	446	−297
Barley (Plot 4 AA), 6 years, 1852–1857	6874	3926	2948		

(1) Only 200 lbs. after the first 7 years of wheat, and 6 of barley.
(2) Only 100 lbs. after the first 7 years of wheat, and 6 of barley.

Before directing attention to the results themselves, it should be premised that, as in the last experiments quoted, the wheat plot had grown 8 crops, liberally dressed with artificial manures, prior to the period to which the figures refer ; but the results with barley commence with the first year of the experiments, and the application of 400 lbs. of ammonia-salts to that crop was only continued for the 6 years referred to. To the wheat, however, the application has been continued up to the present time ; and, over 20 years, it has yielded an average of more corn, though less straw and total produce, than over the first 6 years. It would be concluded, therefore, that the wheat plot was not unduly exhausted at the commencement; and that the comparison between the two crops over the first 6 years would, probably, be but little open to objection on the score of difference in previous condition of the land.

Taking first the *produce per acre* of the two crops, there is, as with the smaller quantity of ammonia-salts, considerably more barley-grain than wheat-grain; but, on the other hand, less barley straw; and an annual average of only 446 lbs. more total produce (corn and straw) of barley than of wheat, instead of nearly 1400 lbs., as when the smaller quantity of ammonia-salts was employed. This difference of result is doubtless due to the proportionally much less increase of barley for a given amount of ammonia in manure with the larger than with the smaller supply of ammonia-salts. The probability is that, in the case of the autumn-sowing for the wheat, the distribution, the state of combination, and the loss by drainage are such, that the quantity of the supplied nitrogen remaining available within a given range of soil when active growth commences in the spring is not excessive, and does not induce over luxuriance; whereas, the same amount applied in the spring for the barley, being less subject to either rapid distribution or drainage, induces too much luxuriance, and, consequently, leads to the laying of the crop, and to reduced eventual productiveness.

The less difference between the produce of wheat and of barley when the larger quantity of ammonia-salts is applied, is, therefore, due, in great measure, to a proportionally less effect on the barley. Nevertheless, the fact of a less amount of produce per acre from a given amount of mineral manure and ammonia-salts applied in the autumn for wheat, than from the same amount applied in the spring for barley, is again clearly illustrated.

If, however, the *increase* of produce with ammonia over that without it be taken as the basis of illustration, the result is different. Thus, instead of an annual average of 446 lbs. more total produce (corn and straw together) of barley than of wheat, there is of *increase* of produce by the mineral manure and 400 lbs. of ammonia-salts over that by the mineral manure alone, less in the case of the barley than of the wheat. The average annual deficiency is 137 lbs. of corn, and 160 lbs. of straw, or 297 lbs. of total produce (corn and straw together). This difference is accounted for by the fact that there is an average of 743 lbs. more total produce of barley than of wheat by the mineral manure alone; there is, therefore, so much more to be deducted from the produce by the mineral manure and the ammonia-salts together; leaving, of course, so much less to be reckoned as increase due to the action of the ammonia-salts.

Reference has already been made to the probable or possible cause of the much greater produce of barley than of wheat by the mineral manure alone (p. 289). On this point it should be borne in mind that, for the wheat the mineral manures, as well as the ammonia-salts, are applied in the autumn, whereas for the barley both are applied in the spring. It is a question, therefore, whether there be not a much greater dilution and distribution of the autumn-sown mineral manures by the winter rains; a locking-up of some of their constituents in difficultly soluble combinations within the soil; hence a less active root-development in the upper and more highly nitrogenous layers of the soil when growth commences in the spring; and hence, also, less luxuriance in the case of the wheat; but, on the other hand, a more rapid exhaustion of the previously accumulated nitrogen within the soil by the barley. If this be so, the higher produce of barley than of wheat by mineral manures alone is, in a sense, accidental, and may prove not to be permanent. In that case, the comparison of the actual *produce* will more fairly illustrate the difference of effect of the mineral manure and a given amount of ammonia-salts applied to wheat and to barley, than will that of the mere *increase* over the produce by the mineral manure alone; and the less amount of increase of barley than of wheat so calculated in these last experiments, will prove no exception to the conclusion arrived at from the results of the other experiments, namely, that a given amount of ammonia-salts applied in the spring for barley is more productive than an equal amount applied in the autumn for wheat.

Briefly enumerated, the very important results, obtained by the use of nitrogenous and mineral manures together, are—that much more than the average barley crop of the country has been obtained for 20 years in succession on the same land, by the annual application, in the spring, of 200 lbs. of ammonia-salts, and 3½ cwts. superphosphate of lime; that the addition of salts of potass, soda, and magnesia, gave no further increase; and that the application, for the same period, of the same amount of ammonia-salts (with mineral manure) in the autumn, for wheat, gave nearly 37 per cent. less corn, nearly 14 per cent. less straw, and about 24 per cent. less total produce. The causes of the remarkable differences of result with wheat and with barley will be considered in Section IV.

Average annual produce and increase by Rape-cake.

Rape-cake is estimated to contain, on the average, about 4·75 per cent. of nitrogen. It also contains a large amount of carbonaceous organic substance, and about 8 per cent. of mineral matter. It has been applied on 4 plots each year; on one alone, on one with superphosphate, on one with the "mixed alkali-salts," and on one with both superphosphate and the mixed alkali-salts. For the first 6 years 2000 lbs. = 95 lbs. nitrogen, were applied per acre per annum; but during the next 14 years only 1000 lbs. = 47·5 lbs. nitrogen. Table XXXVIII. (p. 308) shows the produce over the first 6 years with the larger amount, over the last 14 years with the smaller amount, and both produce and increase over the whole 20 years.

It is first to be observed that where the rape-cake is used without superphosphate, Plots 1 and 3, there is much less deficiency of produce, both corn and straw, compared with Plots 2 and 4 with superphosphate, than in the experiments with ammonia-salts without, compared with those with, superphosphate. The fact is that the rape-cake itself supplies some phosphates; so that superphosphate has less effect when added to it than to ammonia-salts. The general result is, that the rape-cake alone, and the rape-cake and mixed alkali-salts, yield considerably more of both corn and straw than ammonia-salts alone, or ammonia-salts and mixed alkali-salts; but, where used with superphosphate, there is more produce of both corn and straw from a less amount of nitrogen supplied as ammonia-salts, or nitrate of soda, than from a larger quantity in rape-cake.

Thus, over the first 6 years, rape-cake in amount supplying 95 lbs. of nitrogen per acre per annum was applied, and over the same period ammonia-salts = 82 lbs. of nitrogen. But where each was used with superphosphate, whether without or with the addition of the mixed alkali-salts, there was more produce of both corn and straw by the ammonia-salts than by the rape-cake. In fact, there was not much less barley-grain, though a greater deficiency of straw, with superphosphate and ammonia-salts = only 41 lbs. of nitrogen, than with superphosphate and rape-cake = 95 lbs. of nitrogen.

Over the next 14 years the application of rape-cake was reduced to 1000 lbs. per acre per annum = 47·5 lbs. nitrogen; and where ammonia-salts = 82 lbs. nitrogen had previously been applied, the quantity was also reduced to one-half = 41 lbs. nitrogen. The result in each case was that, with superphosphate and the reduced amount of nitrogenous manure, there was an average annual produce of about as much corn, though less

TABLE XXXVIII.—Average Annual Produce and Increase by Rape-cake.

Plots.	MANURES PER ACRE, PER ANNUM.	AVERAGE ANNUAL PRODUCE, &c.				AVERAGE ANNUAL INCREASE, 20 YEARS, 1852–1871.	
	2000 lbs. Rape-cake, 6 yrs., 1852-'57. 1000 lbs. Rape-cake, 14 yrs., 1858-'71. Without Mineral Manure, and with Mineral Manures as under.	First Period, 6 Years, 1852–'57.	Second Period, 14 Years, 1858–'71.	Total Period, 20 Years, 1852–'71.	Second Period, over (or under −) First.	Over (or under −) Mean Unmanured.	Over (or under −) corre-sponding Mineral Manures.
	Dressed Corn, per Acre—Bushels.						
					Per Cent.		
1 C	Without Mineral Manure ..	48¼	44	45⅜	− 8·8	24⅜	
2 C	Superphosphate of Lime ..	47¾	46½	46⅞	− 2·6	25⅞	21¼
3 C	Mixed Alkali-salts	44½	43¼	43¾	− 2·8	22¾	21¼
4 C	Superphosphate and Mixed Alkali-salts	48	47⅛	47½	− 1·8	26½	20
	Total Corn, per Acre—lbs.						
1 C	Without Mineral Manure ..	2664	2527	2568	− 5·1	1380	
2 C	Superphosphate of Lime ..	2673	2660	2664	− 0·5	1476	1225
3 C	Mixed Alkali-salts	2505	2489	2494	− 0·6	1306	1226
4 C	Superphosphate and Mixed Alkali-salts	2662	2713	2698	1·9	1510	1148
	Straw (and Chaff), per Acre—Cwts.						
1 C	Without Mineral Manure ..	31⅝	24¾	26⅞	−21·9	14¾	
2 C	Superphosphate of Lime ..	32⅜	26⅝	28⅜	−17·8	16¼	15
3 C	Mixed Alkali-salts	30¼	25¾	27⅛	−15·0	15	14⅞
4 C	Superphosphate and Mixed Alkali-salts	32½	28¼	29½	−13·1	17⅜	15⅛
	Total Produce (Corn Straw, and Chaff), per Acre—lbs.						
1 C	Without Mineral Manure ..	6212	5296	5571	−14·7	3029	
2 C	Superphosphate of Lime ..	6305	5646	5844	−10·5	3302	2913
3 C	Mixed Alkali-salts	5895	5369	5527	− 8·9	2985	2886
4 C	Superphosphate and Mixed Alkali-salts	6300	5875	6002	− 6·7	3460	2840
	Weight per Bushel of Dressed Corn—lbs.						
1 C	Without Mineral Manure ..	51·0	55·0	53·8	7·8	1·4	
2 C	Superphosphate of Lime ..	51·2	55·0	53·9	7·4	1·5	0·7
3 C	Mixed Alkali-salts	51·1	54·9	53·7	7·4	1·3	0·7
4 C	Superphosphate and Mixed Alkali-salts	50·7	54·9	53·6	8·3	1·2	2.0
	Corn to 100 Straw.						
1 C	Without Mineral Manure ..	75·4	92·4	87·3	22·5	−0·8	
2 C	Superphosphate of Lime ..	74·1	90·5	85·6	22·1	−2·5	−11·[illegible]
3 C	Mixed Alkali-salts	74·2	87·5	83·5	17·9	−4·6	− 8·[illegible]
4 C	Superphosphate and Mixed Alkali-salts	73·3	87·2	83·0	19·0	−5·1	−13·[illegible]

straw, than with the previous too heavy dressings. There was, moreover, not only more corn and more straw by the superphosphate and the reduced amount of ammonia-salts, but also more where ammonia-salts = only 41 lbs. of nitrogen had been used from the commencement, than by the superphosphate and the rape-cake.

The nitrogen of the nitrogenous organic matter of the rape-cake would doubtless be much less rapidly available than that supplied in ammonia-salts; and analysis of the soil has shown that the rape-cake has left a considerable residue of nitrogen near the surface; nor can there be any doubt that, since the excessive dressings of both ammonia-salts and rape-cake have been stopped, there has annually been some effect due to the unexhausted residue of nitrogen previously applied.

The general result is, that about 9 cwts. of rape-cake per acre per annum have given a produce exceeding the average crop of the country, but not quite a maximum yield for the soil and seasons in question. The mineral constituents of the rape-cake doubtless serve to render effective the nitrogen associated with them; though there can be little doubt that the increase yielded is mainly dependent on the amount of nitrogen rendered available by the decomposition of the nitrogenous organic matter of the rape-cake. But since the effect is less for a given quantity of nitrogen supplied, than when ammonia-salts or nitrate of soda is used, it is impossible to decide absolutely whether, or in what degree, the carbonaceous organic matter has been of service. It would yield by decomposition carbonic acid and other products. The increased supply of carbonic acid in the soil would, it must be concluded, not only serve as a source of carbon, but aid the solution and distribution of other plant-food, and so far further growth. But that any such supply is essential for the successful growth of either wheat or barley is clearly disproved by the fact that maximum crops of both have been grown for 20 years or more by means of mineral manures and ammonia-salts, without any return to the soil of carbonaceous organic matter. The carbonaceous organic matter of farmyard manure is obviously equally unessential, so far as the successful growth of the cereals is concerned.

Summary of the Results obtained on the Growth of Barley for 20 Years in succession on the same land, without Manure, and by different descriptions of Manure.

1. Without manure, the average annual produce of barley over 20 years was about 21 bushels of dressed corn, and 12 cwts. of straw. The quality, indicated by the weight per bushel of grain,

was higher over the second than over the first 10 years; but the quantity, of both corn and straw, was between 23 and 24 per cent. less over the second 10 years.

2. Compared with wheat grown for many years in succession without manure, barley gave an average of more corn, less straw, and nearly the same weight of gross produce (corn and straw together); but the barley fell off more in produce of grain, and about equally in straw, over the later years.

3. Farmyard manure applied every year for 20 years, gave an average annual produce of more than 48 bushels of barley-grain, and 28 cwts. of straw. The weight per bushel, quantity of grain, and quantity of straw, were all considerably higher over the second than over the first 10 years. The manure probably supplied from three to four times as much nitrogen as any of the artificial manures, and much more of carbonaceous organic matter, and of every other constituent of the crop, than was contained in the produce. It would leave a large residue of nitrogenous, carbonaceous, and other matters in the soil, which seem to be very slowly available for future crops; but the large accumulation of organic matter increases the porosity of the soil, and its capacity for the retention of moisture; and the crops are thereby rendered both less susceptible to injury from excess of rain, and more independent of drought.

4. As without manure, so with farmyard manure, barley, compared with wheat, yielded, over a series of years, more corn, less straw, but nearly the same quantity of total produce (corn and straw together). This is remarkable, when it is considered that the wheat is autumn-sown and autumn-manured, and the barley spring-sown and spring-manured.

5. Mineral manures alone gave very poor crops, and the quantity of both corn and straw fell off considerably during the later years; but superphosphate of lime alone gave more than salts of potass, soda and magnesia, and not much less than the mixture of all. It may be concluded that the soil was not relatively deficient in any of the mineral constituents which the manures supplied; and, from the falling off in the produce both without manure and with purely mineral manures, it is probable that the growth of the crop under such conditions is gradually exhausting the available nitrogen accumulated within the soil from previous cultivation, manuring, and cropping.

6. Over the same period of 20 years, a mixed mineral manure, containing salts of potass, soda and magnesia, and superphosphate of lime, gave, of barley, much more grain, rather less straw, but considerably more total produce, than of wheat. It is probable that, with the autumn-manuring for the wheat, the various constituents are distributed by the rains, or enter into

less soluble combinations, or both, during the winter; that hence there is less active root-development in the upper and more highly nitrogenous layers of the soil in the spring, and that hence the barley is more rapidly exhausting the accumulated nitrogen of the surface-soil than the wheat.

7. By nitrogenous manures alone (ammonia-salts or nitrate of soda) much more barley was obtained than by mineral manures alone; the produce declined much less in the later years; and, for 20 years in succession, even fair, though not large, crops were obtained. This result is a striking illustration of the mineral resources of such a soil; and it shows that when in what may, in an agricultural sense, be called a corn-exhausted condition, it was deficient in available nitrogen relatively to available mineral constituents.

8. By ammonia-salts and superphosphate of lime together, an average produce of more than 47 bushels of dressed corn, and more than 28½ cwts. of straw, or considerably more than the average barley crop of the country, was obtained over 20 years in succession; and the produce of corn increased, and that of straw in a less degree diminished, giving a higher total produce, during the later than the earlier years. Notwithstanding the great demand made upon the supplies of potass within the soil, by the growth of the crop for so many years by ammonia-salts and superphosphate without potass, the addition of salts of potass, soda and magnesia, gave no further increase of corn, and very little of straw and total produce. The potass-yielding capabilities of such a soil, and the beneficial effects of the use of superphosphate, with nitrogenous manures, for spring-sown corn crops, are here strikingly illustrated.

9. When the same mixed mineral manure, and 200 lbs. of ammonia-salts, were applied per acre per annum for 20 years, in the autumn for wheat, and in the spring for barley, the barley gave more than one-half more corn, nearly one-sixth more straw, and nearly one-third more total produce, than the wheat. When the same mineral manure was used with a larger quantity of ammonia-salts, the result was still in favour of the barley, but in a less degree than with the smaller amount.

10. After applying 400 lbs. of ammonia-salts per acre per annum to barley for 6 years, and then reducing the amount to 200 lbs., the plots so treated gave, for 10 years in succession, more produce than those which had only received 200 lbs. annually from the commencement. It thus appears that the excessive supply of 400 lbs. had left a residue of nitrogen within the soil which was available for succeeding crops.

11. The experiments on barley with nitrate of soda and ammonia-salts respectively, are not exactly comparable with one

another; but, so far as can be judged, a given amount of nitrogen as nitrate of soda has yielded more produce than the same amount as ammonia-salts, and especially so in dry seasons. This is probably due to the greater solubility of the nitrate, or its products of decomposition, to their action on the subsoil, disintegrating it, and rendering it more porous; thus affording more surface for the absorption and retention of moisture and manure, and greater permeability to the roots, rendering the plants less dependent on the fall of rain during growth.

12. By the annual application of rape-cake, whether without or with the addition of mineral manures, more barley than the average crop of the country has been obtained; but, in proportion to the nitrogen it contained, less than by ammonia-salts or nitrate of soda. The mineral constituents of the rape-cake no doubt aid in rendering effective the nitrogen associated with them, though its effects are doubtless mainly dependent on the amount of nitrogen rendered available by the decomposition of its nitrogenous organic matter; but the nitrogen of such matter is much less rapidly available than that of ammonia-salts or nitrates.

13. Over 20 years or more, in succession, ammonia-salts, or nitrate of soda, with mineral manure (without silica), have yielded considerably more of both wheat and barley than the average crops of the country, and more also than either farmyard manure or rape-cake. It is obvious, therefore, that the return to the soil of carbonaceous organic matter as manure is unessential, so far as the successful growth of either of these crops is concerned.

Section III.—Amount of Ammonia in Manure (or its equivalent of Nitrogen in other forms) required to yield a given increase of Grain (and its proportion of Straw).

Comparison of the produce obtained by the different manures has shown—that carbonaceous organic matter, supplied so largely in farmyard manure and rape-cake, is at any rate not essential as manure for either wheat or barley; that mineral manures alone will not yield fair crops of either; that nitrogenous manures give much more produce than mineral manures alone; and that the mixture of nitrogenous and mineral manures will give full crops for many years in succession. In other words—the supply by manure of matter yielding by decomposition carbonic acid, and other carbon compounds, within the soil, has little or no effect; mineral manures alone will not enable the growing plant to obtain sufficient nitrogen from the soil or the atmosphere; when nitrogen in an available form was liberally provided, the

Table XXXIX.—Quantity of Ammonia in Manure—or of Nitrogen in Nitrate of Soda, or Rape-cake, or Farmyard Manure, reckoned as Ammonia—required to produce 1 bushel (= 52 lbs.) increase of Barley Grain, and its proportion of Straw, according to the quantity applied per acre, to the available supply of Mineral constituents within the soil, and to the seasons.

Series I.—200 lbs. Ammonia-salts per acre, 20 years, 1852–1871; without, and with, Mineral Manures.

Plots.	Mineral Manure, &c.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	Averages: 6 Years, 1852–'57.	10 Years, 1858–'67.	4 Years, 1868–'71.	10 Years, 1852–'61.	10 Years, 1862–'71.	20 Years, 1852–'71.	Plots.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
1 A.	Without Mineral Manure	5·17	3·55	3·25	3·88	4·19	3·82	4·61	18·05	3·41	3·23	2·82	2·30	2·95	4·01	4·22	3·67	9·88	3·43	3·30	2·25	[illegible]·89	3·63	3·51	4·15	3·30	3·68	1 A.
2 A.	Superphosphate of Lime	4·28	5·36	2·28	3·90	4·48	2·00	2·12	3·04	1·75	1·59	1·69	1·53	1·62	1·88	1·63	2·42	2·52	1·47	1·83	1·94	[illegible]·26	1·81	1·87	2·60	1·80	2·13	2 A.
3 A.	Mixed Alkali-salts	4·88	3·86	2·97	4·44	4·06	4·63	4·73	24·75	3·75	3·61	2·72	2·18	2·51	4·10	5·20	3·07	4·47	2·90	3·23	2·35	4·03	3·59	3·07	4·38	3·04	3·59	3 A.
4 A.	Superphosphate and Mixed Alkali-salts	1·73	8·89	2·46	4·39	4·18	2·54	2·33	3·17	1·91	1·84	2·00	1·91	1·90	2·17	1·98	2·04	2·65	1·86	2·27	1·95	3·81	2·08	2·07	2·95	2·03	2·41	4 A.
5 A.	Superphosphate and Sulphate Potass		3·20	2·15	3·11	3·76	2·00	1·98	2·88	1·63	2·15	1·68	2·00	1·85	1·83	2·14	2·92	2·09	1·67	1·61	1·78		2·03	1·78	2·37([1])	1·91	2·10([2])	5 A.
	Means	4·77	4·97	2·72	3·91	4·19	3·00	3·15	10·38	2·49	2·49	2·18	1·99	2·17	2·80	3·03	2·82	4·32	2·23	2·45	2·05	3·75	2·63	2·46	3·29	2·42	2·78	

Series II.—400 lbs. Ammonia-salts per acre, first 6 years, 1852–'57; 200 lbs. next 10 years, 1858–'67; 275 lbs. Nitrate Soda last 4 years, 1868–'71; without, and with, Mineral Manure.

Plots.	Mineral Manure, &c.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	6 Years, 1852–'57.	10 Years, 1858–'67.	4 Years, 1868–'71.	8 Years, 1864–'71.	14 Years, 1858–'71.	20 Years, 1852–'71.	Plots.
1 AA.	Without Mineral Manure	5·77	6·18	3·85	6·00	4·16	4·09	2·62	5·63	4·05	2·49	2·67	1·76	2·47	3·03	3·36	3·75	6·15	2·79	2·96	2·85	4·81	2·89	2·79	2·93	2·87	3·53	1 AA.
2 AA.	Superphosphate of Lime	5·92	9·16	3·87	7·08	6·49	2·83	1·77	2·71	1·79	1·17	1·57	1·53	1·72	1·93	1·53	2·41	1·82	1·47	1·56	1·80	5·06	1·77	1·65	1·74	1·74	2·49	2 AA.
3 AA.	Mixed Alkali-salts	5·96	6·73	4·93	7·78	9·41	5·38	2·84	7·16	3·15	2·72	2·28	1·75	2·42	3·81	4·32	3·05	3·45	3·13	2·97	2·68	6·38	2·93	3·03	3·14	2·96	3·93	3 AA.
4 AA.	Superphosphate and Mixed Alkali-salts	7·29	9·07	4·46	10·10	5·99	3·50	1·89	2·91	1·75	1·71	1·86	1·67	1·93	1·95	1·59	1·87	1·64	1·58	1·71	2·09	5·86	1·87	1·74	1·77	1·83	2·68	4 AA.
	Means	6·24	7·79	4·28	7·74	6·51	3·95	2·28	4·60	2·69	2·10	2·10	1·68	2·14	2·68	2·70	2·77	3·27	2·24	2·30	2·36	5·53	2·37	2·30	2·40	2·35	3·16	

Series III.—As Series II., and 400 lbs. Silicate of Soda per acre, 8 years, 1864–1871.

Plots.	Mineral Manure, &c.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	4 Years, 1864–'67.	4 Years, 1868–'71.	8 Years, 1864–'71.	Plots.
1 AAS.	Without Mineral Manure	2·18	2·79	2·17	3·12	3·37	2·19	2·14	1·49	2·50	2·11	2·29	1 AAS.
2 AAS.	Superphosphate of Lime	1·86	1·98	1·51	2·36	2·59	1·41	1·62	1·65	1·88	1·73	1·80	2 AAS.
3 AAS.	Mixed Alkali-salts	1·85	2·49	2·00	2·15	1·48	1·95	1·74	1·62	2·09	1·68	1·86	3 AAS.
4 AAS.	Superphosphate and Mixed Alkali-salts	1·72	1·85	1·66	1·91	1·56	1·42	1·53	1·79	1·78	1·56	1·66	4 AAS.
	Means	1·90	2·28	1·84	2·39	2·25	1·74	1·76	1·61	2·04	1·77	1·90	

Series IV.—Superphosphate and Sulphate Potass first year, 1852; Nitrate of Soda, 19 years, 1853–1871.

Plots.	Manure	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	5 Years, 1853–'57.	10 Years, 1858–'67.	4 Years, 1868–'71.	14 Years, 1858–'71.	19 Years, 1853–'71.	Plots.
1 N.	275 lbs. Nitrate Soda, 19 years, 1853–'71		5·13	3·42	3·21	3·19	2·71	3·28	4·86	3·21	2·04	2·31	1·76	2·77	2·59	2·52	2·89	4·73	2·14	2·23	1·83	3·38	2·63	2·39	2·56	2·74	1 N.
2 N.	550 lbs. Nitrate Soda, 5 years, 1853–'57; 275 lbs. Nitrate Soda, 14 years, 1858–'71		9·74	4·59	6·73	3·81	3·35	2·31	3·91	2·69	1·85	2·13	1·61	2·02	2·31	1·87	2·50	1·46	1·90	1·76	1·61	4·86	2·20	2·06	2·16	2·81	2 N.

Series V.—2000 lbs. Rape-cake per acre, first 6 years, 1852–'57; 1000 lbs. next 14 years, 1858–'71; without, and with, Mineral Manure.

Plots.	Mineral Manure, &c.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	6 Years, 1852–'57.	10 Years, 1858–'67.	4 Years, 1868–'71.	14 Years, 1858–'71.	20 Years, 1852–'71.	Plots.
1 C.	Without Mineral Manure	9·87	7·83	4·21	6·71	5·67	2·87	1·69	2·01	2·91	1·32	2·01	1·74	2·08	2·01	1·69	2·44	2·40	1·83	1·79	1·89	5·26	1·91	1·95	1·92	2·72	1 C.
2 C.	Superphosphate of Lime	13·28	15·96	5·21	6·79	5·83	3·62	1·98	2·72	2·57	1·65	2·20	2·16	2·40	2·10	1·97	2·48	3·05	1·68	2·07	2·69	6·49	2·21	2·25	2·22	3·19	2 C.
3 C.	Mixed Alkali-salts	17·20	11·39	5·00	8·10	7·75	3·58	2·01	2·66	2·74	1·61	2·93	1·96	2·15	2·10	2·03	2·38	2·55	2·02	2·25	1·91	6·83	2·19	2·16	2·18	3·18	3 C.
4 C.	Superphosphate and Mixed Alkali-salts	21·19	21·06	5·78	8·38	7·29	4·46	2·17	3·20	2·45	2·05	2·16	2·32	2·49	2·31	1·99	2·44	2·85	1·69	1·98	2·19	8·02	2·35	2·10	2·22	3·10	4 C.
	Means	15·46	14·06	5·06	7·50	6·61	3·63	1·96	2·66	2·68	1·66	2·40	2·05	2·28	2·21	1·92	2·41	2·71	1·81	2·02	2·17	6·65	2·17	2·12	2·11	3·12	

Series VI.—14 tons Farmyard Manure per acre, every year; 20 years, 1852–1871.

Plots.	Manure	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	10 Years, 1852–'61.	10 Years, 1862–'71.	20 Years, 1852–'71.	Plots.
7.	Farmyard Manure, 20 years, 1852–'71	53·21	21·15	11·06	15·07	15·94	10·23	7·18	8·46	8·01	5·69	6·13	6·12	5·63	6·95	5·80	7·69	7·55	6·68	6·56	5·73	10·62	6·44	8·02	7.

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([1]) Average of 9 Years only, 1853–'61. ([2]) Average of 19 Years only, 1853–'71.

mineral constituents of the soil were insufficient for its full effect; but when so supplied, the mineral manures, which alone had little effect, greatly increased the efficacy of the supplied nitrogen.

The general result is, that whilst it is essential that there be a liberal provision of mineral constituents, the amount of produce was more dependent on the supply of *available nitrogen within the soil* than of any other constituent. The practical questions obviously arise—How much ammonia, or of its equivalent of nitrogen in some other form, will, on the average, be required to yield a given amount of increase of barley-grain, and its average proportion of straw? and how much will the quantity vary, according to the amount applied per acre, to the supply of mineral constituents, and to the characters of the seasons?

The folding Table XXXIX. (facing this page) shows the amount of ammonia—or of nitrogen in nitrate of soda, or rape-cake, or farmyard manure, reckoned as ammonia—required to yield 1 bushel (52 lbs.) of increase of barley-grain, and its proportion of straw, under a great variety of conditions of manuring, and in each of the 20 seasons. In each case the increase is calculated over the produce on the corresponding plot without nitrogenous manure; that is, 1 A, 1 AA, 1 AAS, 1 C, over 1 O; 2 A, &c., over 2 O; and so on; 1 N, and 2 N (with nitrate of soda), and 7 (with farmyard manure), are taken over the mean unmanured produce (1 O and 6-1). The average result for different periods, or series of years, is also given. Where there has been no change of manure, the averages are, as a rule, calculated for the first half, the second half, and the total period; and where there has been any change, for the periods so indicated; also, for the sake of comparison, for corresponding periods in other cases.

The five plots receiving 200 lbs. of ammonia-salts per acre per annum for 20 years are classed in the Table as Series I. Of these, Plot 1 A has had the ammonia-salts without any mineral manure; 2 A with superphosphate; 3 A with sulphates of potass, soda, and magnesia: 4 A with superphosphate and sulphates of potass, soda, and magnesia; and 5 A with superphosphate and sulphate of potass. Taking the average for the 20 years in each case, the quantity of ammonia required to produce 1 bushel increase of barley, and its proportion of straw, is, on the three plots with superphosphate 2·13, 2·41, and 2·10 lbs.; on the plot with salts of potass, soda, and magnesia, without superphosphate, 3·59 lbs.; and on the one without any mineral manure at all 3·68 lbs.

Thus, taking the mean of the three experiments with superphosphate, the amount of ammonia required is rather under 2¼ lbs.;

but with the mixed alkali-salts without superphosphate, and without any mineral manure at all, it is between $3\frac{1}{2}$ and $3\frac{3}{4}$ lbs. That is to say, a given amount of ammonia-salts was more than one-and-a-half-time as effective when there was a liberal provision of mineral constituents, but especially of phosphates, within the reach of the roots, than when there was not.

Assuming that, with otherwise favourable soil-conditions, and with an application of not more than 50 lbs. of ammonia per acre, an increase of 1 bushel of barley (52 lbs.), and its straw, may, on the average of seasons, be obtained for every 2 to $2\frac{1}{4}$ lbs. of ammonia applied, still, it is seen that the amount may vary very greatly according to the characters of the seasons. Thus, on Plot 2 A, with superphosphate, only about $1\frac{1}{2}$ lb. was required in the favourable seasons of 1863 and 1869, but in the bad seasons of 1853 and 1856, 5·36 and 4·48 lbs. respectively, were required.

These great differences according to season occurred, it should be remembered, when only a moderate amount of ammonia-salts was used, and when it was employed under favourable conditions as to mineral manures. But even with the same moderate application, but at the same time less favourable soil-conditions, that is without superphosphate, or without any mineral manure, the differences in the amount required to yield a given increase of produce are very much greater. Thus, when the same quantity of ammonia-salts is used without any mineral manure (Plot 1 A), there is a variation in the amount of ammonia required to yield 1 bushel of increase from 18·05 lbs. in 1859, to 2·25 lbs. in 1871; and when with salts of potass, soda, and magnesia, but without superphosphate (Plot 3 A), from 24·75 lbs. in 1859, to 2·18 lbs. in 1863. In fact, in 1859, there was scarcely any increase at all by ammonia-salts when not accompanied by phosphates; and reference to the characters of the season, and of the growth (pp. 114-116), will show that there was probably defective root-development; a condition under which any deficiency of phosphates within a limited range of soil would very unfavourably affect the characters of growth.

Lastly in regard to Series I:—Under each of the five conditions as to mineral manuring, the amount of ammonia required to produce a given increase of grain was very much less over the second than the first 10 years. It has already been shown that the last 10 seasons were the more favourable for the production of corn, and more especially so where superphosphate was used. But, as there was a greater falling off over the later years where the mineral manures were used alone, the further amount of produce obtained where the mineral manures and ammonia-salts were used together, which is reckoned as increase due to ammonia, was proportionally higher over the last ten years, than was the increase in the actual produce of corn per acre. Further, the actual produce of straw per acre was uniformly, and that of the total produce (corn and straw), taking the average of the plots, rather lower, over the last ten years. That the total produce was lower rather than higher over the later years, seems to afford evidence that, with this smaller dressing of ammonia-salts, there was little or no effect in succeeding, from accumulation in preceding years.

When, as in Series II., double the quantity, or 400 lbs. ammonia-salts, was applied per acre per annum for the first six years, the average amount of ammonia required to yield 1 bushel of increase was, according to the same mode of calculation, without mineral manure, 4·81 lbs.; with superphosphate, 5·06 lbs.; with mixed alkali-salts 6·38 lbs.; and with superphosphate and mixed alkali-salts, 5·86 lbs. Thus, the amount required appears to be less without, than with either of the mineral manures, less with superphosphate than with superphosphate and mixed alkali-salts, and less with the latter than with mixed alkali-salts without superphosphate. The apparently more favourable result without than with mineral manure, is explained by the fact, that the increase by ammonia-salts is, in each case, calculated over the produce by the corresponding unmanured or mineral-manured produce, as the case may be; and as the produce by mineral manures, especially if containing phosphates, was so much higher than that without manure, there is so much more to deduct from the produce with ammonia-salts in addition; and hence, though the produce by the ammonia-salts with mineral manure is much higher, the increase so reckoned as due to the ammonia only is less.

During the next ten years, the quantity of ammonia-salts was reduced from 400 lbs. to 200 lbs.; and during the last four years the ammonia-salts were replaced by 275 lbs. of nitrate of soda, estimated to contain the same amount of nitrogen as 200 lbs. ammonia-salts, namely 41 lbs. = 50 lbs. ammonia. Over both of these periods the result is much more favourable with each of the four conditions as to mineral manure than during the first six years, and also relatively much more so where the superphosphate was employed. This depends in part on the fact that, whilst the produce without manure or by the mineral manures alone, which is the standard over which the increase by ammonia is calculated, declined perceptibly from year to year, that where ammonia was used either did not decline at all, or did so much less rapidly; and hence the increase calculated as due to the ammonia (or nitrogen reckoned as ammonia) is higher.

In reference to these results it should further be observed, that since there is evidence that the excessive supply of ammonia-salts during the first six years left a residue of nitrogen which was effective for ten, if not more, years afterwards, not only do the figures for the first six years understate the total or final effect of the ammonia applied during that period, but those for the subsequent years overstate the result for those years. The average columns of the Table give, however, not the mere arithmetical means of the results for the individual years, but the direct averages for the periods; and the result over the twenty years is, that, instead of only 2·13 lbs. of ammonia required when superphosphate and only 200 lbs. of ammonia-salts were used, there were 2·49 lbs. required when, for the first 6 of the 20 years, 400 lbs., for the next 10 years 200 lbs., ammonia-salts, and for the last 4 years 275 lbs. nitrate of soda, were applied. There is also a considerably less favourable result without than with the superphosphate. Lastly, as in the experiments with the smaller quantity of ammonia-salts every year, the variation of result according to season is very considerable; but, owing to the excess of ammonia applied in the early years, and to the effects of the accumulation afterwards, the exact figures for the individual years cannot be taken in illustration of the point.

During the last eight years of the twenty, one-half of the plots of Series II. received, besides the same manures as the other half, 400 lbs. of silicate of soda, per acre, per annum. The four portions so treated are respectively designated 1 AAS, 2 AAS, &c.; and the results are recorded in the Table under the heading of Series III. Almost every year it was quite obvious to the eye that there was a marked effect from the silicate on Plots 1 and 3, that is where no superphosphate was used; but comparatively little, if any, on Plots 2 and 4 with superphosphate. So striking was this result, that the silicate was examined in the laboratory to ascertain whether it contained any phosphate. It was found not to contain any; nor did it contain nitrate or nitrogen in any other form. Perhaps the most probable supposition is, that by the action of the alkaline silicate on the soil, otherwise locked up phosphoric acid was rendered available for the plants. It is possible, however, that, when the superphosphate was used, a secondary result of its action within the soil was the liberation of silicates, which, without it, were not available in sufficient quantity; and hence the little effect of the direct supply of silicates where the superphosphate was used, and the marked effect where it was not employed. Or, is it that when the acid-phosphate and alkaline silicate are mixed together, they are rendered comparatively insoluble and inactive? The result may perhaps be due in part to more than one of these actions.

Whatever may be the explanation of the fact, the Table shows that there was, in almost every year of the eight, comparatively little difference in the amount of ammonia required to yield a bushel of increase of barley on Plots 2 and 4 of Series II. with superphosphate but without the silicate, and on Plots 2 and 4 of Series III. with superphosphate and with silicate. On the other hand, on Plots 1 and 3 of Series III., without superphosphate, but with silicate, the amount of ammonia required for a given effect was much less than on the corresponding plots of Series II. without the silicate. There was also a greater increase of straw by the use of the silicates where superphosphate was not, than where it was employed.

The next experiments to consider are those with nitrate of soda alone (Series IV.). 1 N received, for nineteen years in succession, 275 lbs. nitrate of soda, containing nitrogen = 50 lbs. ammonia; and 2 N received, for the first five of the nineteen years, double the amount, or 550 lbs. = 100 lbs. ammonia, and afterwards, for fourteen years, only 275 lbs., as Plot 1 N. But as, in the first year of the twenty, both plots received superphosphate of lime and sulphate of potass in considerable amount, which doubtless increased the effects of the nitrogen subsequently supplied for many years, if not for the whole period, the results of 1 N are not strictly comparable with those of 1 A receiving annually the same amount of nitrogen as ammonia-salts, nor are those of 2 N comparable with those of 1 AA. As the figures stand, however, the average of twenty years with ammonia-salts, and of nineteen with nitrate of soda = 50 lbs. of ammonia, shows with the ammonia-salts 3·68 ammonia, and with the nitrate, nitrogen = only 2·74 lbs., required to yield 1 bushel increase of grain and its straw; and with the double amount during the first few years, the ammonia-salts show 3·53, and the nitrate only 2·81 lbs. required. It has already been explained (pp. 290-2) that enough phosphoric acid and potass were applied on the nitrate plots in the first year, to supply as much of these constituents as would be contained in the excess of produce by the nitrate over that by the ammonia-salts throughout the subsequent period; so that, obviously, only part of the better result of the nitrate can be supposed to be due to the condition of combination of its nitrogen.

The result is, at any rate, remarkable, that after mineral manures once applied, nitrate of soda alone should, for nineteen years in succession, yield a result in proportion to its nitrogen, comparatively so little inferior to ammonia-salts used every year in conjunction with superphosphate, or with superphosphate and salts of potass, soda and magnesia.

The next experiments are those of Series V., in which rape-cake was used without, and with mineral manures. During the first

6 years 2000 lbs., and during the last 14 years 1000 lbs. per acre per annum were applied. The rape-cake is calculated to contain 4·75 per cent. of nitrogen. This estimate is not founded on direct analysis of the lots actually employed, but is deduced from our own and published results on various samples in the market. Adopting it, the 2000 lbs. would contain 95 lbs. nitrogen = 115·4 lbs. ammonia, and the 1000 lbs., 47·5 lbs. nitrogen = 57·7 lbs. ammonia.

As the manure leaves a considerable residue for future crops, and would especially do so during the first 6 years, the calculation of the whole of the nitrogen supplied, against the increase obtained during that period, does not show the total or final effect of the nitrogen so supplied; whilst, during the succeeding 14 years, the figures will represent the result too favourably, in so far as a portion of the increase will doubtless be due to accumulation from the previous applications; and this would probably be more considerable, and more effective, than in the case of the double supply of ammonia-salts (Series II.). Accordingly, the figures show much more nitrogen applied for the production of a bushel of increase during the first 6, than during the last 14 years.

As already explained, the increase is, as in the experiments with ammonia-salts, calculated over the produce on the corresponding plots without nitrogenous manure. This plan is, upon the whole, less open to objection than taking the increase in each case over the unmanured produce; but a consideration of the results will show that it is by no means without objection.

The general result is, that the experiments with rape-cake show less difference and less beneficial effect due to the mineral manures also used, than those with ammonia-salts. Thus, comparing the results with rape-cake over the last 14, or the 20 years, with those of Series II., with ammonia-salts over the same periods (both manures being applied in double quantity during the first 6 years), considerably less nitrogen, reckoned as ammonia, is calculated to have been required to yield a given increase with ammonia-salts than with rape-cake when superphosphate was also used, but considerably less with rape-cake than with ammonia-salts, when each was used without superphosphate.

The fact is that rape-cake itself contains phosphates and other mineral constituents, which serve to render the nitrogen associated with them the more effective. It is obvious, therefore, that calculating the increase by the rape-cake alone over the produce without manure, and that by rape-cake and mineral manure over the produce by the corresponding mineral manure alone, gives a relatively too favourable result for the rape-cake where it is used alone, and too unfavourable where it is used with the mineral manures. For, when used alone, the increase so reckoned as due to the nitrogen only, includes that due to the associated mineral constituents of the rape-cake; but when used with mineral manures, the increase due to the mineral constituents directly applied is deducted. On this point it may be mentioned that, if the increase were, in all four experiments with rape-cake, calculated over the unmanured produce, the result would appear, both actually and relatively, more favourable where mineral manures were also used, than the figures in the Table show.

The comparison between the ammonia-salts and the rape-cake is, of course, so far as the nitrogen is concerned, the fairest where the mineral conditions were the most equally favourable with both manures; that is where superphosphate was used. The less favourable result with the rape-cake under these conditions is, doubtless, due to its nitrogen becoming less rapidly available than that of the ammonia-salts. Still, upon the whole, it would appear that not very much more nitrogen is required in rape-cake than in ammonia-salts to yield a given amount of immediate increase; and an advantage of the rape-cake is, not only that it itself supplies mineral constituents, so that with it less superphosphate, if any, will be required, but that its nitrogen will probably be less liable to loss by drainage than that of ammonia-salts or nitrate of soda. On the other hand, a given amount of nitrogen costs more in rape-cake than in either sulphate of ammonia or nitrate of soda.

The last illustrations relate to the results obtained by farmyard manure. As in the case of the rape-cake, the quantity of nitrogen applied can only be approximately estimated. In the calculations it has been assumed that the dung contained 0·64 per cent. of nitrogen = 0·77 per cent. of ammonia. This result is arrived at by calculations founded on the average composition of the matters supposed to enter into the dung. It agrees almost precisely with determinations recently made in dung from the farmyard at Rothamsted; but it is rather less than has been found here in good box dung. It is almost exactly the mean of the results of Boussingault and Voelcker for fresh dung. But it is considerably higher than results recently published by Professor Anderson.

As has been stated, the produce on the farmyard-manure plot has increased considerably in recent years; and accordingly the Table shows much less nitrogen = ammonia required to yield a bushel of increase in the later than in the earlier years. There has indeed been a great accumulation, the effects of which have been only very gradually developed. Taking the average of the 20 years, however, it has required 8 lbs. of ammonia, or its equivalent of nitrogen, in dung, to yield one bushel increase of barley, and its straw; in other words, nearly four times as much as when a mixture of ammonia-salts and superphosphate was employed. This is a striking illustration of the slowness of the return from nitrogen supplied in farmyard manure compared with that in ammonia-salts or nitrate of soda. It is obviously an important question whether less or more of the at first unrecovered amount is lost by drainage, or otherwise, in the one case than the other? or whether the residue from the one description of manure is more or less effective than that from the other? These points have already been referred to in some of their aspects, and will be further considered in the next Section (IV.); but data are still wanting for their full and satisfactory settlement.

From a review of the whole of the data brought forward relating to the point, the practical conclusion may be drawn, that when an increase of barley is obtained by means of artificial manures, such as sulphate of ammonia, or nitrate of soda, or Peruvian guano, an increase of 1 bushel of grain (52 lbs.), and its proportion of straw (say 63 lbs.), may, taking the average of seasons, be calculated upon for every 2 to $2\frac{1}{4}$ lbs. of ammonia, or its equivalent of nitrogen (1·65 to 1·86 lb.), supplied in the manure—provided the amount applied be not excessive, and provided there be no deficiency of mineral constituents within the soil.

These conditions will be fulfilled when barley, grown after dunged roots carted off, or after another corn crop, is manured by from $1\frac{1}{2}$ to 2 cwts. of sulphate of ammonia, or $1\frac{3}{4}$ to $2\frac{1}{4}$ cwts. of nitrate of soda, with 2 to 3 cwts. of superphosphate, per acre; or, from 3 to 4 cwts. of Peruvian guano, containing 12 per cent. of ammonia, without superphosphate.

When, however, rape-cake is used, rather more nitrogen in that form will be required to yield a given increase of the crop for which it is applied; but when the increase is obtained by sheep-folding, or farmyard manure, very much less will be obtained in the first crop, in proportion to the nitrogen contained in the manure.

In our Report on the growth of wheat for twenty years in succession on the same land, it was shown for that crop, as now it is for barley, that the quantity of increase obtained for a given amount of ammonia, or its equivalent of nitrogen, in manure, varied exceedingly according to the amount applied, to the provision of mineral constituents within the soil, and to the seasons. It was, however, stated, as a general practical conclusion, that, under the conditions the most camparable with those of ordinary practice, approximately 5 lbs. of ammonia, or its equivalent of nitrogen, were on the average required to yield 1 bushel increase of wheat, and its proportion of straw. Now, 1 bushel of wheat may be reckoned to weigh 61 lbs., and its average proportion of straw 105 lbs. Thus, whilst from 2 to $2\frac{1}{4}$ lbs. of ammonia in manure will yield 52 lbs. barley-grain, and 63 lbs. straw = 115 lbs. total produce, it required 5 lbs. to yield 61 lbs. of wheat-grain, and 105 lbs. straw = 166 lbs. total produce.

It is clear that it required much more nitrogen in manure to yield a given amount of increase of produce when applied in the autumn for wheat, than when in the spring for barley.

The questions remain—what proportion of the supplied nitrogen is recovered in the immediate increase of crop?—what becomes of the unrecovered amount, if any?—does it, wholly or in part, remain in the soil?—if so, what will be its effect on succeeding crops?—or, lastly, is there any material loss, by drainage, or otherwise? These points will next be considered.

Section IV.—On the Effects of the unexhausted Residue from previous Manuring upon succeeding Crops, loss of constituents by Drainage, and some allied Points.

In the foregoing pages incidental reference has frequently been made to the effects of the residue from previous manuring upon succeeding crops; but the subject is, in various aspects, of such great importance, that it has been reserved for separate consideration in this place.

For example, it is of very great practical interest to have some exact data, showing—what proportion of the nitrogen, supplied in manure, will probably be recovered in the increase of the crop for which it is applied; whether, or in what degree, the at first unrecovered amount will, on the one hand be retained by the soil, or on the other, be drained away and lost? whether, if retained, it will remain, wholly, or in part, in such a state of combination, and distribution, within the soil, as to be available for succeeding crops? and so on.

Very similar questions obviously arise in regard to the mineral constituents of manures and crops; and so far at least as some of those constituents are concerned, it is very important to be able to refer to direct experimental evidence, bearing on the subject.

But, independently of facts and conclusions of great general interest and importance, when the same manure is applied, and the same crop grown, year after year on the same land, it is essential to a proper interpretation of the average results obtained over a series of years, not only to consider the characters of the seasons, but also whether any particular description of manure, so applied, induces exhaustion of certain constituents, resulting in diminished, or accumulation tending to increased, productiveness from year to year.

In our Report on the growth of wheat for 20 years in succession on the same land, the question of the effects of the unexhausted residue from previous manuring upon succeeding crops, was considered so far as evidence was then at command, and it is proposed to give some further illustrations relating to that crop. The experiments on barley afford but few illustrations of the point; but it will be instructive to call attention to such as are available, to consider how far their indications agree with, and how far they differ from, those relating to wheat, and to endeavour not only to explain the general facts observed, but to ascertain the reason of any differences of result with the two crops.

The effects of the unexhausted residue of nitrogen, supplied as ammonia-salts or nitrate of soda, will first be considered.

Table XL. relates to experiments on barley with ammonia-

TABLE XL.—Effects of the Unexhausted Residue of Nitrogen applied to Barley as Ammonia-salts.

Years.	PRODUCE PER ACRE.								
	Total Corn in Bushels of 52 lbs.			Straw (and Chaff).			Total Produce (Corn and Straw)		
	Mixed Mineral Manure every Year, and—			Mixed Mineral Manure every Year, and—			Mixed Mineral Manure every Year, and—		
	Plot 4 A. 200 lbs. Ammonia-salts every Year.	Plot 4 AA. 400 lbs. Ammonia-salts, 6 Years, 1852–'57; 200 lbs., 10 Years, 1858–'67.	4 AA over (or under –) 4 A.	Plot 4 A. 200 lbs. Ammonia-salts every Year.	Plot 4 AA. 400 lbs. Ammonia-salts, 6 Years, 1852–'57; 200 lbs., 10 Years, 1858–'67.	4 AA, over (or under –) 4 A.	Plot 4 A. 200 lbs. Ammonia-salts every Year.	Plot 4 AA. 400 lbs. Ammonia-salts, 6 Years, 1852–'57; 200 lbs., 10 Years, 1858–'67.	4 AA, over (or under – 4 A.
	Bushels.	Bushels.	Bushels.	Cwts.	Cwts.	Cwts.	lbs.	lbs.	lbs.
Average, 6 years, 1852–'57	$49\frac{7}{8}$	$53\frac{7}{8}$	4	$29\frac{1}{4}$	$36\frac{3}{8}$	$7\frac{1}{8}$	5,863	6,874	1,011
1858	$55\frac{5}{8}$	$60\frac{5}{8}$	5	$29\frac{3}{8}$	$35\frac{3}{4}$	$6\frac{3}{8}$	6,192	7,160	968
1859	$38\frac{3}{4}$	$40\frac{1}{8}$	$1\frac{3}{4}$	$27\frac{1}{4}$	$30\frac{5}{8}$	$3\frac{3}{8}$	5,067	5,517	450
1860	$45\frac{5}{8}$	$48\frac{1}{8}$	$2\frac{1}{2}$	$26\frac{5}{8}$	29	$2\frac{3}{8}$	5,355	5,746	391
1861	$58\frac{3}{4}$	$60\frac{7}{8}$	$2\frac{1}{8}$	$30\frac{1}{2}$	$33\frac{5}{8}$	$3\frac{1}{8}$	6,472	6,937	465
1862	$52\frac{3}{8}$	$54\frac{1}{4}$	$1\frac{7}{8}$	$31\frac{5}{8}$	$33\frac{1}{8}$	$1\frac{1}{2}$	6,273	6,529	256
1863	$61\frac{3}{4}$	$65\frac{7}{8}$	$4\frac{1}{8}$	32	$34\frac{3}{4}$	$2\frac{3}{4}$	6,791	7,323	532
1864	$63\frac{3}{4}$	$63\frac{3}{8}$	$-0\frac{3}{8}$	$34\frac{7}{8}$	$37\frac{1}{4}$	$2\frac{3}{8}$	7,225	7,469	244
1865	49	$51\frac{5}{8}$	$2\frac{5}{8}$	$22\frac{1}{2}$	$24\frac{7}{8}$	$2\frac{3}{8}$	5,075	5,469	394
1866	$50\frac{5}{8}$	$56\frac{3}{4}$	$6\frac{1}{8}$	$27\frac{3}{8}$	$28\frac{1}{4}$	$0\frac{7}{8}$	5,704	6,117	413
1867	$47\frac{1}{8}$	$49\frac{1}{2}$	$2\frac{3}{8}$	$25\frac{1}{2}$	$28\frac{3}{8}$	$2\frac{7}{8}$	5,304	5,753	449
Total ..	$523\frac{3}{8}$	$551\frac{1}{8}$	$27\frac{3}{4}$	$287\frac{5}{8}$	$315\frac{5}{8}$	28	59,458	64,020	4,562
Average	$52\frac{3}{8}$	$55\frac{1}{8}$	$2\frac{3}{4}$	$28\frac{3}{4}$	$31\frac{1}{2}$	$2\frac{3}{4}$	5,946	6,402	456

salts. The two Plots, 4 A and 4 AA, have received the same description and amount of mineral manure every year from the commencement. In addition, 4 A has received 200 lbs. of ammonia-salts per acre every year, but 4 AA 400 lbs., or double the amount the first 6 years, and only 200 lbs., or the same as 4 A, the next 10 years. Any increase, therefore, on Plot 4 AA over 4 A, during the 10 years in which they both received the same amount of ammonia-salts, may presumably be attributed to the extra amount applied to 4 AA during the first 6 years. For the sake of more exact comparison than the record of the actual quantities of dressed corn would afford, the total corn per acre has, in each case, been calculated into bushels of 52lbs.

It appears that, during the 10 years, there was an excess of produce on 4 AA compared with 4 A, due to the unexhausted residue from the previous nitrogenous manuring, of nearly 28 bushels of corn, and just 28 cwts. of straw; or an annual average of $2\frac{3}{4}$ bushels of corn, and $2\frac{3}{4}$ cwts. of straw. It is also to be observed that the excess in the tenth year was almost exactly the same as the average of the 10 years,-showing that the residue was not even then exhausted. There was, then, in this case, a marked effect upon the succeeding barley crops, from the extra ammonia-salts applied in the first 6 years.

Table XLI. shows, in like manner, the effects on succeeding barley-crops of a previous extra supply of nitrogen in the form of nitrate of soda. The two Plots, 1 N and 2 N, each received in the first year, 1852, $3\frac{1}{2}$ cwts. superphosphate of lime, and 300 lbs. sulphate of potass per acre. Each year since, 1 N has received 275 lbs. nitrate of soda, and 2 N 550 lbs. during the first 5 years, but subsequently only 275 lbs., or the same amount as 1 N.

The Table shows that, during the 14 years after the cessation of the extra application of nitrate on Plot 2 N, it continued to give more produce than 1 N, amounting in the 14 years to about $51\frac{1}{2}$ bushels of corn, and rather over 30 cwts. of straw, or to an average per acre per annum of $3\frac{5}{8}$ bushels of corn, and $2\frac{1}{8}$ cwts. of straw. Here, again, as in the experiments with the ammonia-salts, the increase in the last year of the series is almost precisely the same as the average increase over the whole period. The differences from year to year are obviously due to peculiarities of season. The result is clear, however, that with the nitrate, as with the ammonia-salts, there was a somewhat lasting effect from the extra amount applied during the earlier years.

It will be of much interest to compare the above results with barley, with those obtained with wheat; and it is especially desirable to adduce those which bear upon the point relating to

TABLE XLI.—Effects of the Unexhausted Residue of Nitrogen applied to Barley as Nitrate of Soda.

Years.	Produce per Acre.								
	Total Corn in Bushels of 52 lbs.			Straw (and Chaff).			Total Produce (Corn and Straw		
	Plot 1 N. 275 lbs. Nitrate Soda, 19 Years, 1853–'71.	Plot 2 N. 550 lbs. Nitrate Soda, 5 Years, 1853–'57; 275 lbs., 14 Years, 1858–'71.	2 N, over (or under −) 1 N.	Plot 1 N. 275 lbs. Nitrate Soda, 19 Years, 1853–'71.	Plot 2 N. 550 lbs. Nitrate Soda, 5 Years, 1853–'57; 275 lbs., 14 Years, 1858–'71.	2 N, over (or under −) 1 N.	Plot 1 N. 275 lbs. Nitrate Soda, 19 Years, 1853–'71.	Plot 2 N. 550 lbs. Nitrate Soda, 5 Years, 1853–'57; 275 lbs., 14 Years, 1858–'71.	2 N, over (or under −) 1 N.
	Bushels.	Bushels.	Busbels.	Cwts.	Cwts.	Cwts.	lbs.	lbs.	lbs.
Average, 5 years, 1853–'57	$45\frac{3}{8}$	$51\frac{1}{4}$	$5\frac{7}{8}$	$25\frac{1}{2}$	$31\frac{1}{2}$	6	5,226	6,198	972
1858	$41\frac{1}{8}$	$47\frac{5}{8}$	$6\frac{1}{2}$	$20\frac{1}{8}$	$23\frac{5}{8}$	$3\frac{1}{2}$	4,399	5,125	726
1859	$26\frac{7}{8}$	$29\frac{1}{4}$	$2\frac{3}{8}$	$18\frac{3}{4}$	$21\frac{1}{4}$	$2\frac{1}{2}$	3,500	3,905	405
1860	$29\frac{5}{8}$	$32\frac{3}{4}$	$3\frac{1}{8}$	$16\frac{3}{4}$	$18\frac{5}{8}$	$1\frac{7}{8}$	3,416	3,793	377
1861	$42\frac{5}{8}$	$45\frac{1}{8}$	$2\frac{1}{2}$	$27\frac{1}{4}$	$29\frac{5}{8}$	$2\frac{3}{8}$	5,260	5,665	405
1862	$39\frac{7}{8}$	42	$2\frac{1}{8}$	$24\frac{1}{4}$	$24\frac{3}{4}$	$\frac{1}{2}$	4,793	4,959	166
1863	$55\frac{1}{4}$	58	$2\frac{3}{4}$	$30\frac{1}{4}$	$29\frac{7}{8}$	$-\frac{3}{8}$	6,265	6,366	101
1864	$45\frac{3}{8}$	$52\frac{1}{8}$	$6\frac{3}{4}$	$24\frac{1}{8}$	$27\frac{3}{4}$	$3\frac{5}{8}$	5,065	5,820	755
1865	$40\frac{3}{8}$	$42\frac{3}{4}$	$2\frac{3}{8}$	$18\frac{1}{2}$	$21\frac{1}{2}$	3	4,174	4,629	455
1866	$36\frac{3}{4}$	$43\frac{1}{2}$	$6\frac{3}{4}$	$21\frac{1}{8}$	$23\frac{7}{8}$	$2\frac{3}{4}$	4,275	4,941	666
1867	$35\frac{7}{8}$	$38\frac{5}{8}$	$2\frac{3}{4}$	$21\frac{1}{8}$	$21\frac{3}{4}$	$\frac{5}{8}$	4,234	4,438	204
1868	$27\frac{1}{8}$	$27\frac{3}{4}$	$0\frac{5}{8}$	$18\frac{7}{8}$	$17\frac{1}{8}$	$-1\frac{3}{4}$	3,530	3,366	−164
1869	$39\frac{5}{8}$	$42\frac{5}{8}$	3	24	$27\frac{5}{8}$	$3\frac{5}{8}$	4,759	5,313	554
1870	$37\frac{3}{4}$	$43\frac{3}{4}$	6	$13\frac{1}{4}$	$19\frac{1}{8}$	$5\frac{7}{8}$	3,456	4,413	957
1871	$47\frac{1}{8}$	$50\frac{7}{8}$	$3\frac{3}{4}$	$29\frac{1}{4}$	$31\frac{1}{2}$	$2\frac{1}{4}$	5,726	6,175	449
Total ..	$545\frac{3}{8}$	$596\frac{3}{4}$	$51\frac{3}{8}$	$307\frac{5}{8}$	338	$30\frac{3}{8}$	62,852	68,908	6,056
Average	39	$42\frac{5}{8}$	$3\frac{5}{8}$	22	$24\frac{1}{8}$	$2\frac{1}{8}$	4,489	4,922	433

the latter crop, since we are now enabled to give them for 8 years longer than at the time of the last Report.

Plots 5 and 16, referred to in Table XLII., were both variously manured during the first 8 years, 1844–1851. From 1852 to the present time, Plot 5 has every year received a mixed mineral manure containing superphosphate of lime, and sulphates of potass, soda, and magnesia; whilst Plot 16 received annually, for the first 13 years of the period, namely 1852–1864 inclusive, the same mixed mineral manure as Plot 5, but in addition the very excessive amount of 800 lbs. of ammonia-salts per acre per annum. For the crop of 1865, and since, however, Plot 16 has been left unmanured. The 800 lbs. of ammonia-salts would supply annually to the soil about 200 lbs. of ammonia = 164 lbs. of nitrogen; whilst, as will be seen further on, scarcely three-tenths as much was recovered in the average annual increase of wheat (corn and straw) during the 13 years of the application;

so that at the end of that period there remained seven-tenths, or more, of the large amount applied still to be accounted for.

TABLE XLII.—Effects of the Unexhausted Residue of Nitrogen applied to Wheat as Ammonia-salts.

EARS.	PRODUCE PER ACRE.								
	TOTAL CORN IN BUSHELS OF 61 lbs.			STRAW (and Chaff).			TOTAL PRODUCE (Corn and Straw).		
	Plot 5. Mixed Mineral Manure alone, 20 Years, 1852–'71.	Plot 16. Mixed Mineral Manure, and 800 lbs. Ammonia-salts, 13 Years, 1852–'64; Unmanured since.	Plot 16, over (or under –) Plot 5.	Plot 5. Mixed Mineral Manure alone, 20 Years, 1852–'71.	Plot 16. Mixed Mineral Manure, and 800 lbs. Ammonia-salts, 13 Years, 1852–'64; Unmanured since.	Plot 16, over (or under –) Plot 5.	Plot 5. Mixed Mineral Manure alone, 20 Years, 1852–'71.	Plot 16. Mixed Mineral Manure, and 800 lbs. Ammonia-salts, 13 Years, 1852–'64; Unmanured since.	Plot 16, over (or under –) Plot 5.
	Bushels.	Bushels.	Bushels.	Cwts.	Cwts.	Cwts.	lbs.	lbs.	lbs.
erage, years, 52–'64	$18\frac{7}{8}$	$40\frac{7}{8}$	22	$16\frac{1}{2}$	$46\frac{5}{8}$	$30\frac{1}{8}$	3,009	7,713	4,704
1865	15	$34\frac{3}{4}$	$19\frac{3}{4}$	$10\frac{1}{2}$	$25\frac{3}{4}$	$15\frac{1}{4}$	2,091	5,007	2,916
1866	$13\frac{5}{8}$	$18\frac{3}{8}$	$4\frac{3}{4}$	$13\frac{1}{8}$	$17\frac{1}{2}$.	$4\frac{3}{8}$	2,303	3,081	778
1867	$9\frac{1}{2}$	$14\frac{3}{4}$	$5\frac{1}{4}$	$9\frac{1}{4}$	$14\frac{3}{8}$	$5\frac{1}{8}$	1,613	2,512	899
1868	$18\frac{1}{2}$	$23\frac{7}{8}$	$5\frac{3}{8}$	12	$18\frac{1}{4}$	$6\frac{1}{4}$	2,481	3,503	1,022
1869	$15\frac{3}{8}$	$16\frac{3}{8}$	1	$14\frac{1}{4}$	$14\frac{3}{4}$	$0\frac{1}{2}$	2,543	2,647	104
1870	$19\frac{5}{8}$	$19\frac{3}{4}$	$0\frac{1}{8}$	$12\frac{1}{8}$	12	$-0\frac{1}{8}$	2,564	2,557	–7
1871	$12\frac{5}{8}$	$13\frac{3}{4}$	$1\frac{1}{8}$	$12\frac{7}{8}$	$13\frac{3}{4}$	$0\frac{7}{8}$	2,207	2,380	173
tal ..	$104\frac{1}{4}$	$141\frac{5}{8}$	$37\frac{3}{8}$	$84\frac{1}{8}$	$116\frac{3}{8}$	$32\frac{1}{4}$	15,802	21,687	5885
erage	$14\frac{7}{8}$	$20\frac{1}{4}$	$5\frac{3}{8}$	12	$16\frac{5}{8}$	$4\frac{5}{8}$	2,257	3,098	841

Stated broadly and in round numbers, the result is as follows:—By the actual utilization, or appropriation, of say three-tenths of the nitrogen annually supplied, there was obtained, over the 13 years of the application, an average produce of nearly 41 bushels of wheat grain, and more than $46\frac{1}{2}$ cwts. of straw, or an average annual increase over the produce by the mixed mineral manure alone, during the same period, of 22 bushels of grain and 30 cwts. of straw. During the 7 succeeding years, the seven-tenths of the supplied nitrogen, which was not thus recovered in the increase of crop in the years of its application, yielded an average annual produce of only $20\frac{1}{4}$ bushels of grain and $16\frac{5}{8}$ cwts. of straw, or an average annual increase over the produce by the mineral manure alone (Plot 5) of only $5\frac{1}{2}$ bushels of grain and $4\frac{5}{8}$ cwts. of straw; whilst during the last 3 years there was scarcely any increase at all. In fact, of the 13 years application, and the 13 years unrecovered nitrogen, amounting to about seven-tenths of the whole supplied, less than the quantity left unrecovered in one year, was effective during the 7 succeeding years; and, practically speaking, nearly the whole of the result was obtained during the first 4 years of the 7. It is true that the mixed mineral manure was not applied on Plot 16 as on Plot 5 during the last 7 years; but with the liberal application during the 13 years and previously, there could be no want of available mineral constituents within the soil; and even if the produce during the 7 years were compared with that without any manure, instead of with that with mineral manure, the annual increase from the residue would appear but little more, and the general result would remain substantially the same.

Again, Plots 5, and 17 and 18, particulars of which are given in Table XLIII., received during the first 8 years (1844–'51) various, but, upon the whole, very similar mixtures of mineral manures, ammonia-salts, and rape-cake; and, as the Table shows, they yielded very similar average annual amounts of produce during that period. In 1852, therefore, the plots were, practically, in very similar condition. For the produce of that year, and each year since, up to the present time, Plot 5 has received a mixture of superphosphate of lime, and sulphates of potass, soda, and magnesia. Over the same period, Plots 17 and 18 have received the same mineral manure, or ammonia-salts, alternately. For example, for the crop of 1852, Plot 17 received 400 lbs. ammonia-salts, and Plot 18 the mineral manure; for that of 1853, Plot 17 received the mineral manure, and Plot 18 the ammonia-salts; and so on, alternately, for the 20 years. Thus, in each year, the one or the other plot was manured with mineral manure, succeeding a dressing of ammonia-salts. These were conditions obviously very favourable for turning to account any residue of the nitrogenous manure of the previous year which might still remain in the soil in a state of combination, and distribution, such as to be available for the plant. The Table shows the produce obtained each year on Plot 5 by mineral manure year after year, and also that obtained each year by mineral manures after ammonia-salts, on Plot 17, or 18, as the case may be.

It is seen that the mineral manure on Plot 17, or 18, each year succeeding a liberal dressing of ammonia-salts for the crop of the previous year, gave, in 20 years, only $16\frac{3}{8}$ bushels of corn and $22\frac{1}{8}$ cwts. of straw, or annually only $\frac{3}{4}$ bushel of corn and $1\frac{1}{8}$ cwt. of straw, more than Plot 5, which received the same mineral manure every year without the interposition of any ammonia-salts.

The result is, then, that when 400 lbs. of ammonia-salts per acre were used for wheat, the unexhausted residue of nitrogen, if any, gave very little increase of produce in succeeding years;

TABLE XLIII.—Effects of the Unexhausted Residue of Nitrogen applied to Wheat as Ammonia-salts.

YEARS.	PRODUCE PER ACRE.								
	TOTAL CORN IN BUSHELS OF 61 lbs.			STRAW (and Chaff).			TOTAL PRODUCE (Corn and Straw).		
	Plot 5. Mixed Mineral Manure alone, 20 Years, 1852–'71.	Plots 17 or 18. Mixed Mineral Manure, every Year succeeding 400 lbs. Ammonia-salts; 20 Years, 1852–'71.	Plots 17 or 18, over (or under −) Plot 5.	Plot 5. Mixed Mineral Manure alone, 20 Years, 1852–'71.	Plots 17 or 18. Mixed Mineral Manure, every Year succeeding 400 lbs. Ammonia-salts; 20 Years, 1852–'71.	Plots 17 or 18, over (or under −) Plot 5.	Plot 5. Mixed Mineral Manure alone, 20 Years, 1852–'71.	Plots 17 or 18. Mixed Mineral Manure, every Year succeeding 400 lbs. Ammonia-salts; 20 Years, 1852–'71.	Plots 17 or 18, over (or under −) Plot 5.
	Bushels.	Bushels.	Bushels.	Cwts.	Cwts.	Cwts.	lbs.	lbs.	lbs.
Average, 8 Years, 1844–'51	31¼	32	0¾	28¾	29¾	1	5,122	5,280	158
1852	17⅛	14⅝	−2½	17⅝	15⅜	−2¼	3,019	2,621	−398
1853	9¾	8⅝	−1⅛	18¼	17⅞	−0⅜	2,640	2,534	−106
1854	25½	24⅞	−0⅝	22⅜	21⅜	−1	4,067	3,917	−150
1855	18¾	19⅛	0⅜	16⅛	16⅞	0¾	2,960	3,059	99
1856	19¾	18⅝	−1⅛	18½	17⅝	−0⅞	3,274	3,111	−163
1857	23⅞	26⅜	2½	15	17⅞	2⅞	3,137	3,612	475
1858	19¾	23	3¼	14⅛	17¾	3⅝	2,795	3,393	598
1859	20⅞	19¾	−1⅛	21⅛	21⅝	0½	3,633	3,636	3
1860	15	15½	0½	14½	15½	1	2,539	2,678	139
1861	17⅜	19⅝	2¼	13⅞	15¼	1⅜	2,616	2,906	290
1862	18⅛	19⅜	1¼	16½	18½	2	2,960	3,248	288
1863	21⅛	22⅝	1½	15⅜	17	1⅝	3,017	3,290	273
1864	17¾	18⅜	0⅝	12¼	13⅝	1⅜	2,462	2,654	192
1865	15	18	3	10½	13⅛	2⅝	2,091	2,568	477
1866	13⅝	13¼	−0⅜	13⅛	13½	0⅜	2,303	2,328	25
1867	9½	10⅞	1⅜	9¼	11	1¾	1,613	1,893	280
1868	18½	19¾	1¼	12	14⅜	2⅜	2,481	2,807	326
1869	15⅜	16½	1⅛	14¼	15⅛	0⅞	2,543	2,705	162
1870	19⅝	20½	0⅞	12⅛	12¼	0⅛	2,564	2,628	64
1871	12⅝	16	−3⅜	12⅞	16¼	3⅜	2,207	2,797	590
Total ..	349	365⅜	16⅜	299¾	321⅞	22⅛	54,921	58,385	3464
Average	17½	18¼	0¾	15	16⅛	1⅛	2,746	2,919	173

whereas, when the same amount of ammonia-salts was used for 6 years in succession for barley, there was an excess of produce, doubtless due to the unexhausted residue of nitrogen, which averaged 2¾ bushels of corn, and 2¾ cwts. of straw, per acre per annum, for 10 years in succession, with evidence that the effect was not even then at an end.

Thus, it was shown in Sections II. and III. that a given amount of nitrogen in manure yielded more increase of barley than of wheat in the years of its application; and it is now seen that it also leaves a more effective residue when applied for barley than for wheat. The questions arise—What proportion of the supplied nitrogen is, in either case, recovered in the increase of crop? What becomes of the unrecovered amount, if any? How is it that more increase is obtained, and that there is apparently less loss, in the case of the barley than of the wheat?

In our first paper in this Journal, now more than twenty-five years ago, we pointed out that about 5 lbs. of ammonia in manure had been found necessary for the production of 1 bushel of increase of wheat and its straw. Frequently since, the question of the proportion of the nitrogen of manure recovered in the increase of produce obtained has been illustrated by results of the direct analysis of the produce. This was done, so far as barley is concerned, in the Report on the first 6 years of the experiments (Vol. xviii., 1858). In a paper "On the Annual Yield of Nitrogen per Acre in Different Crops," read at the meeting of the British Association for the Advancement of Science held at Leeds in 1858, it was concluded that, with wheat and barley indifferently, rather more than four-tenths of the supplied nitrogen was recovered in the increase. Again, in a paper "On the Sources of the Nitrogen of Vegetation, &c.,"* much the same estimate was arrived at for wheat, for barley, and for meadow-hay; and estimates were also made in regard to some other crops.

The subject is, however, one of such great importance, and the number of years over which the estimate can be made is now so much greater than formerly, that numerous new analyses have been made for the purposes of this paper. The nitrogen has thus been determined in the produce for 20 years (1852-1871), of six of the wheat, and five of the barley plots; also, but for 3 years only, in that of three of the experimental oat plots. For the oats the nitrogen has been determined in the grain and in the straw of each year separately; but, for the wheat, and for the barley, respectively, a mixture has been made of the produce (corn and the straw separately) of each plot, for the 20 years, the quantity taken being in exact proportion to the amount of produce per acre each year. The whole was then ground up together; so that the mixed samples respectively represent the produce of the grain and of the straw of each plot, for the 20 years.

Table XLIV. (p. 329) shows the amount of nitrogen recovered in the increase of produce (corn and straw), and the amount not recovered, for 100 supplied in manure.

For *wheat*, the plots selected are—that with 14 tons farmyard

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* 'Philosophical Transactions,' Part II., 1861; also 'Jour. Chem. Soc.,' new series, vol. i., 1863.

TABLE XLIV.—Nitrogen Recovered, and not Recovered, in Increase of Produce, for 100 supplied in Manure.

Plots.	MANURES PER ACRE, PER ANNUM.	For 100 Nitrogen in Manure. Recovered in Increase.	For 100 Nitrogen in Manure. Not Recovered in Increase.
	Wheat—20 Years, 1852–1871.		
6	Mixed Mineral Manure and 200 lbs. Ammonia-salts (= 41 lbs. Nitrogen)	32·4	67·6
7	Mixed Mineral Manure and 400 lbs. Ammonia-salts (= 82 lbs. Nitrogen)	32·9	67·1
8	Mixed Mineral Manure and 600 lbs. Ammonia-salts (= 123 lbs. Nitrogen)	31·5	68·5
16	Mixed Mineral Manure and 800 lbs. (1) Ammonia-salts (= 164 lbs. Nitrogen)	28·5	71·5
9 A	Mixed Mineral Manure and 550 lbs. (2) Nitrate Soda (= 82 lbs. Nitrogen)	45·3	54·7
2	14 tons Farmyard Manure every year.	14·6	85·4
	Barley—20 Years, 1852–1871.		
4 A	Mixed Mineral Manure and 200 lbs. Ammonia-salts (= 41 lbs. Nitrogen)	48·1	51·9
4 AA	Mixed Mineral Manure and { 400 lbs. Ammonia-salts (= 82 lbs. Nitrogen) 6 years, 1852–'57 .. 200 lbs. Ammonia-salts (= 41 lbs. Nitrogen) 10 years, 1858–'67 .. 275 lbs. Nitrate Soda (= 41 lbs. Nitrogen) 4 years, 1868–'71 .. }	49·8	50·2
4 C	Mixed Mineral Manure and { 2000 lbs. Rape-cake (= 95 lbs. Nitrogen) 6 years, 1852–'57 .. 1000 lbs. Rape-cake (= 47·5 lbs. Nitrogen) 14 years, 1858–'71 .. }	36·3	63·7
7	14 tons Farmyard Manure every year.	10·7	89·3
	Oats—3 Years, 1869–1871.		
4	Mixed Mineral Manure and 400 lbs. Ammonia-salts (= 82 lbs. Nitrogen)	51·9	48·1
6	Mixed Mineral Manure and 550 lbs. Nitrate Soda (= 82 lbs. Nitrogen)	50·4	49·6

(1) 13 years only, 1852–1864. (2) 475 lbs. Nitrate = 71 lbs. Nitrogen in 1852; 275 lbs. = 41 lbs. Nitrogen in 1853 and 1854; 550 lbs. = 82 lbs. Nitrogen each year afterwards.

manure per acre per annum for 20 years; those with mixed mineral manure and 200 lbs., 400 lbs., 600 lbs., and 800 lbs., of ammonia-salts, per acre per annum; and that with the same mineral manure and 550 lbs. nitrate of soda per acre per annum.

For *barley*, the plots are—that with 14 tons farmyard manure per acre per annum for 20 years; that with the same mixed mineral manure as for the wheat, and 200 lbs. ammonia-salts per acre per annum for 20 years; that with the same mineral manure for 20 years, 400 lbs. ammonia-salts for the first 6 years, 200 lbs. for the next 10 years, and 275 lbs. nitrate of soda for the last 4 years of the 20; and that with the same mineral manure and 2000 lbs. rape-cake for the first 6 years, and 1000 lbs. for the next 14 years.

For *oats*—the plot with the same mixed mineral manure as for wheat and for barley, and 400 lbs. ammonia-salts; also that with the same mineral manure and 550 lbs. nitrate of soda per acre per annum, but for three years only.

The increase in the amount of nitrogen in the produce by the use of it in manure is, in the cases of the artificial mixtures of nitrogenous and mineral manure, calculated over the amount determined in the produce by the corresponding mineral manure without ammonia. The increase in the produce of nitrogen by farmyard manure is also calculated over that by the purely mineral manure.

According to the figures, there was, with the same mixed mineral manure and 200 lbs. of ammonia-salts per acre per annum for 20 years in succession, rather less than one-third of the supplied nitrogen recovered in the increase of the wheat, but nearly one-half in that of the barley.

With the same mineral manure, and 400 lbs. ammonia-salts applied for 20 years for wheat, and 400 lbs. for 6 years, 200 lbs. for 10 years, and 275 lbs. nitrate for 4 years—in all 20 years—for barley, there was recovered in the increase of the wheat, again scarcely one-third, but in that of the barley again nearly one-half. With the same mineral manure and 400 lbs. ammonia-salts applied to oats, but for 3 years only, there was even rather more than one-half of the supplied nitrogen reckoned to be recovered in the increase of crop.

When the more excessive amounts of ammonia-salts were applied for wheat, notably less than one-third of the supplied nitrogen was recovered, and the less the greater the excess.

On the other hand, when 550 lbs. of nitrate of soda (containing nitrogen = 400 lbs. ammonia-salts) were applied, there was, even with wheat, not much less than half, and with oats rather more than half of the nitrogen recovered in the increase of crop.

With rape-cake applied for barley, a considerably less proportion of the nitrogen was recovered than with ammonia-salts.

Lastly, with farmyard manure, whether applied to wheat or to barley, very much less of the supplied nitrogen was recovered than with any of the artificial manures. Indeed, assuming the dung to have provided about 200 lbs. of nitrogen per acre per annum, there was recovered in the increased produce of the wheat only about one-seventh, and in that of the barley scarcely one-ninth, of the nitrogen supplied by the manure.

The general result of this new and more extended inquiry is, then—that with neither crop is the whole of the supplied nitrogen recovered in the increase of produce obtained; that when a given amount of ammonia-salts was applied a much less proportion was recovered in wheat than in either barley or oats; but that, even with wheat, more was recovered when nitrate of soda was employed than when ammonia-salts were used.

How is the apparent loss to be explained? and how is it that a greater loss is observed with wheat than with either barley or oats?

In the paper in the 'Philosophical Transactions' (Part II. 1861),* already referred to, after showing the relation of the nitrogen in increase to that in manure in some particular cases, we submitted the following questions:—

"Is the unrecovered amount of supplied Nitrogen or at any rate a considerable proportion of it, drained away and lost?

"Are the nitrogenous compounds transformed within the soil, and their Nitrogen, in some form, evaporated?

"Does the missing amount for the most part remain in some fixed combination in the soil, only to be yielded up, if ever, in the course of a long series of years?

"Is ammonia itself, or Nitrogen in the free state, or in some other form of combination than ammonia, given off from the surface of the growing plant? Or, lastly,

"When Nitrogen is supplied within the soil for the increased growth of the Graminaceous crop, is there simply an unfavourable distribution of it, considered in relation to the distribution of the underground feeders of the crop?—the Leguminous crop, which alternates with it, gathering from a more extended range of soil, and leaving a residue of assimilable Nitrogen within the range of collection of a next succeeding Cereal one?"

Briefly enumerated, the three main sources of loss of nitrogen here suggested are, then—*drainage; accumulation within the soil in a state of combination, or distribution, unfavourable for being taken up by the immediately succeeding crop; or evolution in some form from the surface of the growing plant.*

From some of the results reported in the same paper, and also

* "On the Sources of the Nitrogen of Vegetation; with special reference to the question whether plants assimilate free or uncombined Nitrogen." By Lawes, Gilbert, and Pugh.

from other considerations, we concluded, in opposition to the view we had previously been disposed to entertain, that the last-named of these, that is, *evolution from the plant*, did not take place.

With regard to *drainage*, the previous results of Professor Way,* and especially the subsequent ones of the experiments conducted at Rugby under our superintendence for the Royal Sewage Commission,† led us to attribute great importance to that part of the subject. In the course of that inquiry we arranged for the collection of sixty-two samples of drainage-water, the partial analysis of which was conducted by Professor Way; and, comparing the results with those on the corresponding samples of sewage, it was obvious that but a small proportion of the nitrogen of the sewage which was not obtained in the increase of produce was recovered in the drainage-water in the form of ammonia. We therefore arranged for the collection of some special samples for complete analysis, and especially for the determination of the nitric acid, if any, in both sewage and drainage-water. The results showed considerably more nitrogen in the drainage in the form of nitric acid than in that of ammonia. Indeed, it was obvious that a large proportion of that important manurial constituent of the sewage was drained away and lost. Satisfied for the time with this indication, it was not contemplated to follow up that part of our general inquiry until the question of the accumulation of nitrogen within the soil itself had first been investigated.

After the publication, in 1864, of the results of the growth of wheat for twenty years in succession on the same land, the subject of the composition of the crop, according to season and manure, was resumed; and it was determined to examine both the soils and the drainage-waters from the different plots, to see whether there was, on the one hand an accumulation of nitrogen in the soil, and on the other a loss by drainage. The nitrogen was determined in the first 9 inches, the second 9 inches, and the third 9 inches; or, in all, to a depth of 27 inches of soil. The results were given at the Meeting of the British Association for the advancement of Science at Nottingham, in 1866, and the following quotation from the abstract of that paper will indicate their general bearing:—

"The accumulation of nitrogen from the residue of manuring

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* "On the Composition of the Waters of Land-Drainage and of Rain." ('Journal Royal Agricultural Society of England,' vol. xvii. Part I.)

† "On the Sewage of Towns" (Third Report and Appendices 1, 2, and 3, of the Royal Commission, 1865). Also—"On the Composition, Value, and Utilisation of Town Sewage" ('Journal of the Chemical Society,' New Series, vol. iv.; entire series, vol. xix., 1866).

was found to be, in some cases, very considerable; but even with equal amounts supplied, it varied, both in total amount and in distribution, according to circumstances, the depth to which the unused supply had penetrated being apparently influenced by the character and amount of the associated manurial constituents. The general result was, that, although a considerable amount of the nitrogen supplied in manure which had not been recovered as increase of crop was shown to remain in the soil, still a larger amount was as yet unaccounted for. Initiative results indicated that some existed as nitric acid in the soil, but it was believed that the amount so existing would prove to be but small. In fact, it was concluded that a considerably larger proportion would remain entirely unaccounted for within the soil to the depth under examination than was there traceable, and the probability was, that at any rate some of this had passed off into the drains, and some into the lower strata of the soil."

It was at the same time shown, by reference to field results, how very small was the increase of subsequent wheat crops due to the large residue of nitrogen accumulated in the soil, notwithstanding its amount was many times greater than that which would yield an increase of 20 bushels or more, if applied afresh to soil otherwise in the same condition.

Thus, then, it was established, that there was a considerable accumulation within the soil, of nitrogen supplied in manure and not recovered in the increase of the crop, but that there remained a considerable quantity not so accounted for; and it was concluded that some of this had passed off into the drains, and some into the lower strata of the subsoil.

Being fully occupied at the time with other subjects, and finding that Dr. Voelcker was desirous to investigate the question of land drainage, we gladly provided him with samples of the drainage-water from the differently-manured plots in the experimental wheat-field, and also with full particulars of their history for the purposes of inquiry. In the 'Journal of the Chemical Society of London' (vol. ix. s.s. p. 291, 1871), Dr. Voelcker has published the results of the complete analysis of seventy samples of drainage-water of accurately known history so collected. Those results are a most valuable contribution to our knowledge of the subject, not only in its agricultural bearings, but also in relation to the question of the influence of the sources of potable and other waters upon their composition and quality. For the details we must refer the reader to Dr. Voelcker's own paper; but the following table gives a summary of the results so far as they relate to the loss by drainage of the nitrogen supplied to the soil by manure.

TABLE XLV.—Composition of Drainage-water from Plots differently Manured; Broadbalk Field, Rothamsted; Wheat every Year, commencing 1844.

Nitrogen as Nitrates and Nitrites, per 100,000 parts of Water.
Dr. VOELCKER's Results.

DATES OF COLLECTION, &c.	MANURES PER ACRE, PER ANNUM.						
	14 Tons Farmyard Manure every Year.	Without Manure every Year.	Sulphate of Potass, Soda, and Magnesia and Superphosphate of Lime.				
			Without Nitrogen in Manure since 1851.	And 41 lbs. Nitrogen as Ammonia-salts.	And 82 lbs. Nitrogen as Ammonia-salts.	And 123 lbs Nitrogen as Ammonia-salts.	And 82 lbs. Nitrogen as Nitrate Soda.
	Plot 2.	Plots 3–4.	Plot 5.	Plot 6.	Plot 7.	Plot 8.	Plot 9.
Dec. 6, 1866, full flow ..	1·956	0·648	0·878	1·330	2·170	2·567	0·707
May 21, 1867, full flow ..	..	0·052	0·059	0·089	0·078	0·274	0·785
Jan. 13, 1868, full flow ..	1·256	0·667	0·926	1·704	2·811	3·104	1·196
Apr. 21, 1868, full flow ..	..	0·085	0·137	0·189	0·448	0·578	5·830
Dec. 29, 1868, enormous flow	..	0·500	0·530	0·952	1·493	1·874	0·659
Means	1·606	0·390	0·506	0·853	1·400	1·679	1·835

* The conditions under which the results given in the above (and the next) Table have been obtained, should be further described as follows:—With the exception of Plot 9, as explained below, each plot has been manured as stated in the Table every year, commencing 1852. Further, Plot 2 received 14 tons of farmyard manure every year, commencing 1843-4. The unmanured portion consists of two lands, Plots 3 and 4 respectively, the drain running under the furrow which separates them; Plot 3 has been unmanured since the commencement of the experiments in 1843-4, and for some years previously; whilst Plot 4 has only been unmanured since 1851; for which, and six preceding seasons, it received ammonia-salts and superphosphate of lime; the effects of the unexhausted residue from which are slightly apparent even up to the present time. Each of the other plots consists of two lands, the drain running under the separating furrow. For the crop of 1851, and several preceding seasons, Plot 5 received, besides mineral manure, ammonia-salts in rather heavy dressings, and also some rape-cake. The other plots also received various amounts of nitrogenous and mineral manure in 1851, and previously. Only one of the two lands comprising Plot 9 has received the mineral manure stated (commencing 1855); the other has had the nitrate alone: the quantity

of nitrate applied over the two lands was equal to only 71 lbs. nitrogen per acre in 1852, and to only 61 lbs. in 1853 and 1854, but to 82 lbs. in each year since.

In the first place it will be observed that, in three of the five occasions on which all the other drains ran freely, no result is given for the farmyard manure plot. The fact is that, whilst the pipe-drains from every one of the other plots in the experimental wheat-field run *freely*, perhaps four or five or more times annually, the drain from the dunged plot seldom runs at all more than once a year, and in some seasons not at all. We must refer to a former paper in this Journal * for some further particulars relating to this very important result. Stated briefly, it was found that the dunged soil, when saturated, retained, within 12 inches from the surface, an excess of water which would be equivalent to about 1½ inch of rain more than that held to the same depth on the unmanured and the artificially manured plots in the same field. The conclusion is obvious, that the dunged soil, with its vast accumulation of organic matter, and doubtless greater degree of disintegration, porosity, and power of absorption, especially near the surface, is enabled to retain much more water. Hence a much greater amount and continuity of rain is required to overcome its power of retention, and to reach the drains in its case. This result is one of very great interest and significance. Thus, whether the porosity of a clay soil be increased by the application of manure, by mechanical means, or by a combination of the two, its power to absorb and retain water, in an available and not injurious state, will be proportionately increased; and, not only will the growing crops be thereby rendered more independent of drought, but the necessity for artificial drainage will, at any rate in some soils, be greatly lessened.

Not only does the drain-pipe from the dunged plot seldom run, but it will be observed that the proportion of nitrogen in its drainage water is, in one of the cases given, less than where 82 lbs. of nitrogen were supplied as ammonia-salts, and in the other less than where 41 lbs. of nitrogen were so supplied. This is the case though the dung is estimated to supply to the soil nearly, if not quite, 200 lbs. of nitrogen per acre per annum. In connection with this point it may be stated that analysis of the soil of the dunged plot after 25 years of the application of the manure, showed that the top 9 inches contained nearly twice as high a percentage of nitrogen as the corresponding layer of any of the artificially manured plots. Yet, not once during the 29 years of the experiments has the farmyard-manured plot yielded as high a total produce (corn and straw together) as one or other of the plots manured with mixed mineral manure and ammonia salts or

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* Vol. vii. s.s., Part I., p. 115.

nitrate of soda. It is obvious, that the nitrogen supplied by the dung is retained by the soil in a condition not only much less rapidly available to growing crops, but also much less liable to loss by drainage. Still, there is a large amount of the nitrogen supplied in the dung not yet satisfactorily accounted for.

The Table shows that at each period of collection there was less nitrogen in the drainage-water from the plot the whole of which has been unmanured since 1851, and part for a number of years previously, than from either of the plots artificially manured during the same period. There was, in every case, rather more from Plot 5, which received mineral manure alone in 1852, and each year since; but mineral manure in each, with ammonia-salts, or nitrogenous organic matter, or both, in 7 out of the 8 preceding years. There was, further, in each case, more nitrogen in the drainage-water when, to the mineral manure, ammonia-salts = 41 lbs. of nitrogen was added; with one slight exception again more when 82 lbs. were employed; and more still with 123 lbs. nitrogen supplied.

That is to say, with each increased supply of nitrogen by manure, as ammonia-salts, there was an increased loss of nitrogen as nitric acid in the drainage-water.

It must be borne in mind that, in the experiments on wheat here referred to, the ammonia-salts were always sown broadcast in the autumn, and ploughed or harrowed in before sowing the seed; and it is seen that the amount of nitrogen as nitric acid in the drainage-water is much greater on the three occasions of winter collection, that is, soon after the manures were sown, and when there was no growth, than on either of the two occasions of spring collection, that is, after the washing out by the winter rains, and when active growth had set in.

The nitrate of soda is, however, always sown as a top-dressing about the middle of March. Accordingly, there was, in each case of winter collection, much less nitrogen as nitric acid in the drainage from the nitrated plot (9), than in that from Plot 7, which received the same amount of nitrogen as ammonia-salts applied in the autumn. On the other hand, in both cases of spring collection—that is, after the sowing of the nitrate—the amount of nitrogen as nitric acid was much greater in the drainage from the nitrated plot, than in that from the plot which had received the same amount of nitrogen as ammonia-salts in the autumn. In one case, indeed, April 21, 1868, the nitrate having been applied on March 18, the quantity of nitrogen as nitric acid in the drainage from the nitrated plot amounted to 5·83 parts per 100,000 parts of water. Assuming (which, however, was probably not the case) that an inch of rain passed as drainage of that strength, this would represent a loss of about 13 lbs. of nitrogen per acre! On this point it may be stated that for every inch of rain carrying with it into the drains, or below the reach of the roots, 1 part of nitrogen per 100,000 parts of water, there will be a loss of 2¼ (2·26) lbs. of nitrogen of manure per acre. If this fact be clearly fixed upon the mind, its great practical importance cannot fail to be recognised.

Since this Section was in type, we have been favoured by Professor Frankland with numerous results of analysis of drainage-water from the differently manured plots in the experimental field at Rothamsted, samples of which had, at his request, been supplied to him for investigation. He has also been good enough to give us permission to publish some of the results obtained relating to the amount of nitrogen in the waters in the form of nitrates and nitrites. Accordingly, we have, with his approval, selected for illustration those relating to the same plots as in the case of Dr. Voelcker's analyses, and those relating to six different periods of collection are taken.

When considered in detail—with due regard to the supply of manure, to the previous rainfall, to the period of collection, to

TABLE XLVI.—Composition of Drainage-water from Plots differently Manured; Broadbalk Field, Rothamsted; Wheat every Year, commencing 1844.

Nitrogen as Nitrates and Nitrites, per 100,000 parts of Water. Professor FRANKLAND's Results.

DATES OF COLLECTION, &c.	MANURES PER ACRE, PER ANNUM.						
	14 Tons Farmyard Manure every Year. Plot 2.	Without Manure every Year. Plots 3, 4.	Sulphates of Potass, Soda, and Magnesia, and Superphosphate of Lime.				
			Without Nitrogen in Manure since 1851. Plot 5.	And 41 lbs. Nitrogen as Ammonia-salts. Plot 6.	And 82 lbs. Nitrogen as Ammonia-salts. Plot 7.	And 123 lbs. Nitrogen as Ammonia-salts. Plot 8.	And 82 lbs. Nitrogen as Nitrate Soda. Plot 9.
Jan. 5, 1872, moderate flow	2·592	1·312	1·418	2·777	4·744	7·841	2·311
May 18, 1872, moderate flow		0·031	0·071	0·051	0·059	0·094	1·647
June 11, 1872, small flow		0	0	0	0	(1)	(1)
Oct. 26, 1872, moderate flow	0·932	0·366	0·360	1·354	2·303	1·808	0·975
Jan. 19, 1873, moderate flow	0·084	0·057	0·157	0·454	1·294	1·522	(2)
Feb. 26, 1873, small flow	0·082	0·131	0·088	0·122	0·461	0·441	0·264
Means	0·922	0·316	0·349	0·793	1·477	1·951	1·039

(1) In these cases the drains did not run; and as there was little or no loss of nitrogen from those that did, it is assumed that there was little or none in these, and hence, for fair comparison, the means are—for Plots 3–4, 5, 6, 7, and 8, taken as for 6 experiments. For Plot 2, however, they are only taken for 4, and for Plot 9 for 5, experiments.

(2) On January 19, 1873, the drain from Plot 9 ran a little, but had ceased to do so when the samples were collected.

the growth of the crop, and to the rate of flow—these results of Dr. Frankland's not only strikingly confirm the conclusions drawn from those of Dr. Voelcker, but they afford additional points of interest. Thus, there is not only an obvious gradation in the amount of nitrogen, as nitrates and nitrites, comparing plot with plot, according to the amount of nitrogen supplied in the manure, but, dependent on the conditions above enumerated, there are both higher and lower amounts than in any of the cases investigated by Dr. Voelcker.

In the autumn of 1871 the farmyard-manure plot received its dressing on October 22nd, and the mineral manures and ammonia-salts were applied on October 18 and 22. During November, and the first half of December, there was much less than the usual amount of rain; about the 20th of December there was a fall of rather more than half an inch, and from that time to the end of the month there was more or less rain almost every day; giving, however, a total for the month of considerably less than the average. Still, the soil had gradually acquired a good deal of moisture; and, on December 30th, a few of the drains in the experimental wheat-field ran a little. There was a little rain registered on January 1, 2, and 3, 1872, more than one-quarter of an inch on January 4th, more than half an inch on January 5th, and again more than half an inch on January 6th. On January 4th a few of the drains ran, and on both the 5th and 6th the whole of them. The results given in the first line of the Table (XLVI.) relate to samples collected on January 5th, which was the first occasion on which all the drains ran since the application of the manures in October.

The drainage from the Plots 3–4, both of which have been entirely unmanured since 1851, and one for some years previously, shows the lowest proportion of nitrogen as nitrates; that from Plot 5, which had received mineral manure alone in 1852, and each year since, but mineral manure and ammonia-salts for several years previously, contained rather more; that from Plot 6, with ammonia-salts equal 41 lbs. nitrogen per acre per annum, much more; that from Plot 7, with ammonia-salts equal 82 lbs. nitrogen per acre per annum, again much more; and that from Plot 8, receiving 123 lbs. nitrogen per acre per annum, very much more still—in fact, more than in any other case examined by either Dr. Frankland or Dr. Voelcker, and an amount corresponding to a loss of $17\frac{3}{4}$ lbs. of nitrogen per acre, provided that an inch of rain passed away as drainage of that strength. The drainage from the nitrated plot, on the other hand, which had not received any nitrate since the previous spring, showed less loss of nitrogen than Plot 6, which receives only half the quantity of nitrogen annually, but in the form of ammonia-salts, which had been applied in the autumn.

During the rest of January (1872) some of the drains ran very frequently, and nearly all of them more than once; in March, again, many of them ran twice, and on May 18th there was a discharge from all excepting that from the dunged plot. In fact, in January there was a great excess of rain; in February a fair amount; in March considerably more than the average; in April nearly the average; and in May a considerable excess. Up to the middle of May, therefore, the soil had been subjected to an unusual washing out; whilst growth would then have advanced considerably, and the roots would have established command over the soluble matters within the soil. The result is, that the amount of nitrogen in the drainage at that date was extremely small in all the cases of autumn manuring by ammonia-salts; but it was very much greater where the nitrate had been applied on March 7th. It is true that the actual amount of nitrogen as nitrates and nitrites in a given quantity of the drainage from the nitrated plot was less in May, after the sowing of the manure in March, than it was in January, when no nitrate had been sown, and a crop had been grown since the application of the manure in the previous March; but in May the quantity in the drainage from the nitrated plot was very many times greater than in that from either of the plots which had been manured with ammonia-salts, whilst in January it was less.

After the collection on May 18th, there was about one-third of an inch of rain before the end of the month, bringing up the total to notably more than the average. In June, again, there was an excess of rain, more especially during the first third of the month; on June 9th a few of the drains ran, and on June 11th most of them, though only slowly. Samples of the drainage from eight of the plots were sent to Dr. Frankland; and although in three of them a very small amount of nitrogen as nitrates and nitrites was found, the Table shows that there was none whatever in that from either of the plots to which the results there given refer. This is a very interesting fact; and it is doubtless accounted for, in part by the previous washing out of the soil, and in part by the extent to which the growing crop would, by the middle of June, have availed itself of assimilable nitrogen within the soil.

It only remains to add, in reference to the season thus far referred to, that, after such considerable loss by drainage during the winter, the crops in the experimental wheat-field which had been manured with mineral manure and ammonia-salts, applied in the autumn, were considerably below the average obtained under corresponding conditions in other years, whilst the produce by mineral manure and nitrate of soda—the latter not applied until the spring—was considerably above the average.

From June 11th until October 25th none of the drains ran; but there was a flow from most of them on the 25th, 26th, and 27th of the latter month; and, as the Table shows, samples of the drainage of October 26th were collected and analysed. The dung had been put upon its plot on October 14th; the mineral manures and the ammonia-salts were sown on October 16th and 17th. There was more or less rain registered each day afterwards, until, on the 24th there was about one-third of an inch, on the 25th more than half an inch, and on the 26th nearly nine-tenths of an inch. These heavy rains had come on when the land was only partly ploughed, only one or two plots being finished, and some scarcely touched. At the time of the collection of the drainage, therefore (October 26th), scarcely two plots were in the same condition as to the working of the land, so that some irregularities in the relative composition of the waters would be expected. There was still, in the main, a gradation in the amount of nitrogen as nitrates in the drainage-water, according to the amount of ammonia-salts applied; but the quantities were, throughout, comparatively low for winter-drainage collected soon after the sowing of the manure. This was probably in part due to the soil not having been completely broken up, and the manures, therefore, not being thoroughly distributed, but partly also to washing out, or dilution, for many hours before the samples were collected.

Some of the drains ran, more or less, eight times during November, and most of them two or three times. In December, again, most ran six, and some seven times, completing a year of much more frequent running than any since the observation of them commenced in 1866.

On January 2, 4, and 5, 1873, the drains from all excepting the dunged plot, and on January 3rd, 10th, and 19th, from all, without exception, ran. On January 3rd there was a very full, but at each of the five other dates only a moderate, flow. On January 19th samples were collected from all the plots excepting No. 9, the flow from which had stopped when the collection was made. Since the collection on October 26, 1872, there had been about 5 inches more than the average fall of rain; some of the drains had run more than twenty, and most sixteen or seventeen, times; whilst, even since the beginning of the month, all but the dunged plot had previously run five times. Accordingly, after so much washing out of the soil, the amount of nitrogen as nitrates and nitrites was comparatively small for winter-drainage; but there was very obvious gradation in the amount according to the quantity of ammonia-salts which had been applied.

Between January 19th and February 26th there were frequent, but not heavy rains (or snow-falls), but at the latter date about two-thirds of an inch of melted snow and rain were registered, all the drains ran, and samples were collected and sent to Dr. Frankland. After such an unusual washing out of the soil since the sowing of the manures in October, the drainage of February 26th is seen to contain, for that period of the year, a very small amount of nitrogen as nitrates and nitrites. There is still something like gradation according to the amount of nitrogen supplied in the manure; and, as would be expected, there is less in the drainage from the nitrated plot than in that from Plot 7, which receives the same amount of nitrogen annually, but applied as ammonia-salts in the autumn.

In connection with the very unusually large amount of water passing from the land by drainage during the past winter, 1872–73, it is of much interest to remark that, whilst at the present time (June 1873) the plots in the experimental wheat-field which received their dressing of ammonia-salts in October, are looking very much worse than usual, in fact, extremely unpromising, others, which were top-dressed with ammonia-salts or nitrate of soda in March, show much greater luxuriance.

With regard to the dunged plot (2), it has been explained (p. 335), that, owing to the greatly increased porosity of the soil by the application of farmyard manure so many years in succession, the drains from it very seldom run. It happens, therefore, that they do so only when there is a very great excess of rain; and, when there is such excess, a surface-drain, which first crosses the furrows of all the other plots, then crossed that of the dung, and passed not many yards from the outfall of that plot, has generally been running, so that there has sometimes been doubt whether the drainage from the dunged plot were not more or less affected by the percolation of this surface-water. Other cross-surface drains have, however, from time to time, been cut, to obviate this as far as possible; and it is believed that, at any rate during the past winter, there has been no danger of such percolation. Moreover, the results relating to Plot 2, recorded in the Table, though so different at the four periods of collection, are so far consistent with each other that, in each case, the drainage-water contains somewhat less nitrogen as nitrates and nitrites than that collected at the corresponding date from Plot 6, which received only 41 lbs. of nitrogen per acre per annum, but in the form of ammonia-salts; whilst, as already stated (p. 335), the dung is estimated to supply nearly, if not quite, 200 lbs. of nitrogen per acre per annum. But there has been a great accumulation of the nitrogen supplied by manure in the soil of the dunged plot, especially near the surface, and very much more than in that of the plots manured with ammonia-salts or nitrate of soda. It is further worthy of remark, that there is a general consistency between these results relating to the drainage from the dunged plot, and those obtained by Dr. Voelcker; for, in one case examined by him, the amount of nitrogen as nitrates, &c., also ranged somewhat below that in the drainage from Plot 6, and in the other not much above it.

In regard to wheat, therefore, it has been experimentally established, that, even when a comparatively moderate amount of ammonia-salts was applied as manure, only about one-third of the nitrogen so supplied was recovered in the increase of the crop; that the unexhausted residue, if any, was but very slowly, and very partially recovered as increased yield in succeeding years; that, nevertheless, there was an accumulation within the soil itself, of some of the nitrogen not at first recovered in increase; but that there was a loss by drainage which increased almost in proportion to the amount of nitrogen supplied in the manure.

The question arises—whether the whole of the supplied nitrogen which is not recovered in the crop either remains in the soil, or is lost by drainage? Owing to the difficulty of determining with certainty, either the total amount of nitrogen retained by the soil within the reach of the roots, the proportion of the total rain passing beyond their reach, or the average composition of the drainage, absolute proof on this point is not at command. The following illustration will nevertheless be useful.

Of the total nitrogen supplied to the wheat plot No. 7, during the 20 years, 1852–1871, it may be assumed that about 33 per cent. was recovered in the increase of crop, leaving 67 per cent. to be otherwise accounted for. The determinations of nitrogen made in the samples of soil collected in 1865 are obviously not strictly applicable to the present calculation; but from them it may perhaps be concluded that approximately one-third, or possibly more, of the nitrogen not recovered in the increase of crop, remains accumulated within the soil to the depth of the 27 inches examined. This would leave say 44 per cent. of the 82 lbs. of nitrogen annually applied as manure, or, in other words, an average of 36 lbs. of nitrogen, to be annually accounted for by drainage or otherwise. Now, there can be no doubt that by far the larger proportion, though not the whole, of the drainage takes place during the autumn and winter months; and taking the mean of Dr. Voelcker's three determinations of nitric-acid in the winter drainage from this plot, the amount of nitrogen so found in it is 2·16 parts for 100,000 of water. As 1 inch of rain is equal to a fall of 226,263 lbs. (about 101 tons) of water per acre, every inch passing as drainage beyond the reach of the roots, and containing 1 part of nitrogen per 100,000, would carry with it $2\frac{1}{4}$ (2·26) lbs. of nitrogen per acre; and 2·16 parts per 100,000 would represent a loss of nearly 5 (4·88) lbs. per acre for each inch of rain so passing. At this rate it would require little more than 7 (7·38) inches of rain to pass beyond the reach of the roots to account for the whole loss of nitrogen observed in the case of the wheat plot No. 7.

We have said that the actual amount of drainage is unknown; and since, in the case of the land in question, the subsoil of clay rests upon chalk at from 6 to 10 feet from the surface, and there is, therefore, natural drainage constantly going on, no gauging of the flow of the pipes, however exact, would indicate the total amount of water passing. Other experiments at Rothamsted have, however, proved, that from one-third to one-half of the annual rain may pass below 40 inches. Supposing only one-third of the total fall so to pass, an average of from 8 to 9 inches of rain would annually drain away, by far the greater proportion of which would go off during the autumn and winter months.

The quantity and composition of the drainage-water here supposed would obviously be sufficient to account for more than the whole of the loss of nitrogen from Plot 7 as above indicated. On the one hand, however, some allowance in the way of deduction must be made for the amount of nitrogen as nitrates and nitrites in the drainage, due to accumulations within the soil prior to the period included within the estimate, or to other normal annual sources; but whether, with the large annual supply of nitrogen by manure, and the much more active root development, in the case of Plot 7, the amount of nitrogen in the drainage-water from that plot, due to sources other than the annual direct supply of nitrogenous manure, would be as much as that indicated in the drainage from either plots 3, 4, or 5, may be a question. On the other hand, the proportion of the drainage to the rain-fall, in the case of the soil in question, would probably average more than one-third, which amount only is assumed in the above estimate.

Although the selection of samples sent to Dr. Frankland was very fortunate, so far as the illustration of the wide difference in the composition of the drainage from the same plot at different times is concerned, his results are, on that account, the less directly available as a means of forming a judgment of the probable *average* composition of the drainage throughout any particular season of the year. To this end it would be desirable to have had results relating to the period between January 5 and May 18, 1872; and again to that between October 26, 1872, and January 19, 1873. Still, taking Dr. Frankland's results as they stand, the mean proportion of nitrogen as nitrates and nitrites in the samples of drainage from Plot 7, collected on January 5 and October 26, 1872, and on January 19 and

February 26, 1873, is higher than that in the winter drainage from the same plot examined by Dr. Voelcker, and adopted in the illustrations above given.

It should be added that, even the drainage from the plots manured exclusively with mineral manure and ammonia-salts or nitrate of soda would appear, according to Dr. Frankland's analyses, to contain nitrogen as ammonia and organic nitrogen, in amount averaging about 4 or 5 per cent. as much as that found as nitrates and nitrites, and by so much, therefore, increasing the loss of combined nitrogen by drainage, beyond that indicated by the quantity of nitrates and nitrites alone. In the drainage from the dunged plot, however, the amount of ammonia and organic nitrogen is, both actually, and relatively to the quantity as nitrates and nitrites, much more than in that from the artificially manured plots.

From the foregoing considerations it seems extremely probable that the whole of the nitrogen applied to the wheat as ammonia-salts or nitrate of soda, was either recovered in the increase of the crop, accumulated within the soil, or lost by drainage.

As the experimental barley-field is not artificially drained, we are unable to illustrate the point in the same manner in regard to the barley as to the wheat crop. It has, however, been conclusively shown that, in the case of the barley, a greater amount of increase is obtained for a given quantity of nitrogen in manure than in that of the wheat; and that a larger proportion of the nitrogen supplied is recovered in the increase of produce within a given time. How are these facts to be explained?

From the facts adduced, it is clear that a material loss of nitrogen takes place by drainage in the winter, when ammonia-salts are applied in the autumn for the wheat crop; and since the manures for the barley are not sown until the spring, all loss of the freshly-supplied nitrogen by winter rains is avoided. Further, not only would there be comparatively little drainage after the spring sowing, but growth being at once established, the nitrogen, whether applied in the form of ammonia or of nitrate, would be rapidly taken up. The analyses of the drainage from the wheat-field show that the water collected during the spring contained, compared with that of the winter, very little nitrogen. This is probably partly accounted for by the previous washing out of the soil in the winter, but it is doubtless also in a great measure due to the action of the growing crop. It is only what would be expected, therefore, that a given quantity of ammonia-salts applied for barley in the spring, should yield a much better result than an equal amount applied for wheat in the autumn.

Even in the wheat experiments, nitrate of soda has always been applied in the spring; but as, unfortunately, the same quantities have not been applied for the two crops, no exact comparison can be drawn between the results they respectively yield. Still, the evidence undoubtedly indicates that more increase has been obtained for a given amount of nitrate when applied to barley than to wheat. In this case, therefore, loss by winter drainage cannot account for the comparatively defective result with the latter crop. Part of it is probably due to the fact that the quantity which has been applied for wheat (550 lbs. per acre) is a heavy spring dressing; and, owing to the great solubility of the nitrate, and the little power of retaining it which the soil possesses, there would be a greater loss by spring and summer drainage the greater the quantity applied. In confirmation of this view, Dr. Voelcker's analysis of the drainage from the nitrated plot after the manure had recently been sown, showed twice as much nitrogen as he found in any case of winter drainage from plots receiving the same amount of nitrogen as ammonia-salts. In many seasons too, the crop is too heavy and laid. For barley, on the other hand, only half the amount of nitrate is used; and, consequently, there will probably be not only less loss of manure by drainage, but less loss of crop by laying.

With regard to the supposition that there was probably a less proportional loss of nitrogen by drainage from the nitrate when applied for the barley than for the wheat, it should further be borne in mind, that although the manure is for both crops sown in the spring, yet it is in the one case on land in a close and consolidated condition, and in the other on soil rendered as light and open as possible by recent working, and hence offering a greater surface for absorption and retention of the manure. There is probably also a more active root-development in the upper layers of the soil in case of the barley than in that of the wheat.

Whether or not the above suppositions afford an adequate explanation of the difference of result with the nitrate when applied to both crops in the spring, the difference in the case of the ammonia-salts applied for the wheat in the autumn, and for the barley in the spring, is at any rate much more conclusively accounted for. But there is another circumstance in connection with the point that should not be overlooked.

The proportion of the nitrogen of the ammonia-salts which is recovered in the increase of produce being much greater in the case of the barley experiments than in those with wheat, there remains, of course, much less to be accounted for by accumulation in the soil, and by drainage. There is pretty certainly much less loss by drainage. And, so far as the few determinations of nitrogen that have yet been made in the soils of the barley plots enable us to judge, it would seem probable that there is less accumulation in the soil also, especially in the lower layers. If this be really so, the explanation is that, as the application of the ammonia-salts for the barley is made with the soil in a more porous condition, when there is less risk of saturation by water, therefore less risk of washing out, and when growth almost immediately succeeds, the wide distribution of the ammonia (or of the nitrate resulting from its oxidation) is materially checked; whilst the residue thus remaining near the surface will be the more easily available to the abundant surface rootlets of succeeding barley crops. In this there would obviously be an element in the explanation of the greater effect upon succeeding crops, of the nitrogen of manure not recovered in the immediate increase, when it was applied in the spring for barley than when in the autumn for wheat.

The long continued effect from previous applications of nitrate of soda must obviously be explained in a very different way. As already referred to, a given surface of soil has much less power to retain either nitrate of soda, or other nitrates, than ammonia. Consequently, the nitrogen of the nitrate distributes much more rapidly, and widely, through the soil and subsoil, and, so far, is more liable to loss by drainage. On the other hand it has been explained (p. 140) that the effect of the nitrate, or its products of decomposition, is to cause the disintegration of the clay subsoil, and so to increase its porosity, and, therefore, its surface for the absorption and retention both of moisture and of manurial matters, and also its permeability to the roots. Hence, although a given surface of the clay subsoil will retain much less nitrogen as nitric acid than as ammonia, the surface itself being much increased, the defective power of retention of a given surface will, in so far, be compensated. Accordingly, it has been seen that the barley crop was much more independent of drought on the nitrated plots than on those manured with a corresponding quantity of nitrogen as ammonia-salts; and not only so, for there would appear to be a retention of nitrates by the subsoil, beyond that which would be anticipated considering their solubility; a result which is most probably due to the same increase of disintegration, porosity, and surface, as is assumed to account for the increased retention of moisture in the first instance, and subsequent extended development of root, and yielding up of water to the plant.

At any rate, whatever may be the exact explanation in either case, the facts are undoubted—that there was a considerable effect on succeeding barley crops from previous applications of nitrogen, both as ammonia-salts and as nitrate of soda; and that much greater effects, due to the residue of the supplied nitrogen were observed when ammonia-salts were applied for barley in the spring, than when for wheat in the autumn.

To the foregoing illustrations of the effects of the unexhausted residue from previously supplied nitrogen, must be added some evidence as to the effects on succeeding crops of previously supplied mineral manures, or ash-constituents. The experiments on barley do not furnish absolutely unexceptionable comparative evidence on the point; though there can be little doubt that the superphosphate and sulphate of potass applied in the first year, 1852, on Plots 1 N and 2 N, have materially increased the effects of the nitrate of soda afterwards annually applied up to the present time. The experiments on wheat do, however, afford very conclusive evidence on the subject, and as we are now able to give the results of eight more seasons than when writing on the question in 1864, we append the following Table (pp. 348–9) relating to that crop.

For the crop of 1844, both plots, 10*a* and 10*b*, received a mineral manure, consisting of silicate of potass and superphosphate of lime. Every year since, 10*a* has been manured with ammonia-salts alone. 10*b* has been manured exactly similarly in every year excepting the third, fifth, and seventh (1846, 1848, and 1850); in 1846 it was left unmanured; in 1848 it received, in addition to the ammonia-salts, a mineral manure containing salts of potass, soda, and magnesia, and superphosphate of lime; and in 1850 the same mineral manure without the ammonia-salts. That is to say, during the first six years of the twenty-seven, the application of ammonia-salts was twice omitted on 10*b*, but it twice received mineral manure when 10*a* did not.

The Table shows that during the 6 years, 1845–50, 10*b*, with less ammonia-salts, but more mineral manure, yielded, in the aggregate, $14\frac{5}{8}$ bushels less corn, and $11\frac{1}{2}$ cwts. less straw, or $2\frac{1}{2}$ bushels corn, and $1\frac{7}{8}$ cwt. straw, less per acre per annum than 10*a*. On the other hand, in almost every year since up to the present time, a period of 21 years since the last application of mineral manure, 10*b* has yielded more of both corn and straw than 10*a*; in all $69\frac{3}{8}$ bushels more corn, and $61\frac{7}{8}$ cwts. more straw, or an average annual excess of $3\frac{3}{8}$ bushels of corn, and $2\frac{7}{8}$ cwts. of straw.

It is obvious that the excess of produce on 10*b*, over that on 10*a*, during the last 21 years, may be partly due to the less exhaustion of the mineral constituents of the soil on 10*b* during the first 6 of the 27 years, owing to the less supply of ammonia-salts to it during that period. But, if we deduct the difference between the produce on the two plots during these 6 years, from the excess of produce on 10*b* during the last 21 years, we still have, during the latter period, an aggregate excess of $54\frac{3}{4}$ bushels of corn, and $50\frac{3}{8}$ cwts. of straw, or an average annual excess of $2\frac{5}{8}$ bushels of corn, and $2\frac{3}{8}$ cwts. of straw, on 10*b*,

TABLE XLVII.—EXPERIMENTS ON WHEAT.

Effects on succeeding Crops, of the Unexhausted Residue from previous Applications of Mineral, or Ash-constituents.

Years.	Produce per Acre.								
	Total Corn in Bushels of 61 lbs.			Straw (and Chaff).			Total Produce (Corn and Straw).		
	Mineral Manure, 1844.			Mineral Manure, 1844.			Mineral Manure, 1844.		
	Plot 10*a*. Ammonia-salts, 1845 and each year since. 27 years, 1845–'71.	Plot 10*b*. Ammonia-salts, 1845 and each year since, excepting 1846 and '50; Unmanured 1846; Mineral Manure, 1848 and '50.	10*b* over (or under –) 10*a*.	Plot 10*a*. Ammonia-salts, 1845 and each year since. 27 years, 1845–'71.	Plot 10*b*. Ammonia-salts, 1845 and each year since, excepting 1846 and '50; Unmanured 1846; Mineral Manure, 1848 and '50.	10*b* over (or under –) 10*a*.	Plot 10*a*. Ammonia-salts, 1845 and each year since. 27 years, 1845–'71.	Plot 10*b*. Ammonia-salts, 1845 and each year since, excepting 1846 and '50; Unmanured 1846; Mineral Manure, 1848 and '50.	10*b* over (or under –) 10*a*.
	Bushels.	Bushels.	Bushels.	Cwts.	Cwts.	Cwts.	lbs.	lbs.	lbs.
1844	16½	16½	..	9⅞	9⅞	..	2,120	2,120	..
6 years, 1845–'50 { Total ..	175⅞	161⅛	–14¾	158⅛	146⅝	–11½	28,436	26,263	–2,173
6 years, 1845–'50 { Average	29¼	26⅞	– 2⅝	26⅜	24½	– 1⅞	4,739	4,377	– 362
1851	32⅛	31¾	– 0⅜	27⅜	27¼	– 0⅛	5,036	4,985	– 51
1852	21⅝	22	0⅜	24⅞	25⅛	0¼	4,107	4,162	55
1853	10½	14⅝	4⅛	18¼	24	5¾	2,691	3,578	887
1854	36¼	41½	5¼	32⅛	39⅞	7¾	5,808	7,003	1,195
1855	21	29½	8½	22⅜	29⅛	6¾	3,797	5,073	1,276

1856	24⅝	28¼	3⅝	25⅛	28¼	3⅛	4,323	4,895	572
1857	29¾	35¾	6	21⅜	25⅝	4¼	4,208	5,060	852
1858	23½	29	5½	19	23⅜	4⅜	3,569	4,390	821
1859	19¾	24½	4¾	24⅜	30½	6⅛	3,937	4,920	983
1860	14¾	17⅜	2⅝	19¾	21⅛	1⅜	3,118	3,420	302
1861	14	16⅞	2⅞	17¼	19⅜	2⅛	2,784	3,196	412
1862	23⅞	26⅛	2¼	23⅛	25⅜	2¼	4,050	4,443	393
1863	42⅜	46¾	4⅜	31⅛	36¼	5⅛	6,068	6,914	846
1864	34¼	39¼	5	25¼	29	3¾	4,925	5,642	717
1865	27	31¾	4¾	21¼	23⅞	2⅝	4,034	4,615	581
1866	27¾	30¼	2½	24⅞	27¼	2⅜	4,485	4,895	410
1867	18⅜	20¼	1⅞	18⅛	19⅛	1	3,146	3,375	229
1868	26⅝	30¼	3⅝	19⅜	21⅛	1¾	3,790	4,210	420
1869	19¾	19⅜	− 0⅜	20¼	19½	− 0¾	3,475	3,374	− 101
1870	23¼	24½	1¼	14½	15⅝	1⅛	3,047	3,244	197
1871	11	10¾	− 0¼	11⅛	12	0⅞	1,927	2,002	75
21 years, 1851–'71 Total ..	502⅛	570⅜	68¼	460⅞	522¾	61⅞	82,325	93,396	11,071
21 years, 1851–'71 Average	23⅞	27⅛	3¼	22	24⅞	2⅞	3,920	4,447	527

which amounts at least must be attributed to the residue of the mineral manures supplied now more than 20 years ago.

The wheat experiments afford other illustrations of the lasting effects of certain mineral substances applied as manures; but owing to the very unusual exhaustion of the mineral constituents of the soil by the application of ammonia-salts alone so many years in succession in the cases above cited, the point is sufficiently forcibly brought out to render it unnecessary to adduce further evidence of the same kind on the subject.

The evidence afforded by the analysis of the produce, of the soils, and of the drainage waters, is, however, perfectly consistent with that of the field results.

Thus, numerous analyses of the ash of the grain and the straw of the produce of the experimental wheat plots show that of Plot 10*a* to have become relatively deficient, more particularly in phosphoric acid, but to some extent in potass also, during the later years.

Again, Baron Liebig's son, Hermann von Liebig, who had asked to be provided with samples for investigation, has partially analysed the soils from some of the Rothamsted experimental wheat plots; and so far as the important constituents potass and phosphoric acid are concerned, he finds the amount of these much greater, especially in the upper layers of the soil, the greater the supplies by manure.

Lastly, on this point, Dr. Voelcker's analyses of the drainage waters show, that very much less of potass passed off in that way than of either soda, lime, or magnesia; and also very much less of phosphoric acid than of sulphuric acid or of chlorine; in fact, there is comparatively little loss by drainage of either.

The facts brought out in this Section may be briefly summarised as follows:—

1. When either ammonia-salts, or nitrate of soda, or nitrogenous organic matter in the form of rape-cake, or farmyard manure, was applied for either wheat or barley, a considerable proportion of the nitrogen so supplied remained unrecovered in the increase of the crop for which the manure was employed; nor was the whole recovered in many succeeding crops.

2. When ammonia-salts were applied in the autumn for wheat, a much less proportion of their nitrogen was recovered in the increase of crop, than when they were applied in the spring for barley or for oats.

3. Analysis of the soils to the depth of 27 inches, showed that there was a considerable accumulation within that depth, of the nitrogen of manure which had not been recovered in the increase of the crop; but that a still larger amount remained to be otherwise accounted for.

4. Analysis of the drainage waters from the experimental wheat plots showed that they contained a large amount of nitrogen in the form of nitrates; that the quantity of nitrates in the drainage was the greater the greater the amount of ammonia-salts applied as manure; and that (after autumn sowing), the quantity was very much greater in the winter, than subsequently in the spring and summer.

5. The analysis of the drainage waters further showed—that the winter drainage, after sowing ammonia-salts in the autumn, may often contain from two to three parts (and sometimes much more) of nitrogen (as nitrates and nitrites) per 100,000 parts of water. Calculation showed that, for every one part of nitrogen per 100,000 parts of drainage, there will be a loss of 2¼ lbs. of nitrogen per acre for every inch of rain passing beyond the reach of the roots. In one case Dr. Frankland's analysis showed 7·841 parts of nitrogen per 100,000 parts of drainage, corresponding to a loss of 17¾ lbs. of nitrogen per acre, provided an inch of rain passed as drainage of that strength.

6. A given surface of soil possesses much less capacity of absorption for nitrate of soda, or its products of decomposition, than for the ammonia of ammonia-salts. Consequently, heavy rains soon after sowing would carry off in the drainage water more nitrogen from a dressing of nitrate of soda, than from a corresponding dressing of ammonia-salts. In one case, after a heavy dressing of nitrate of soda in the spring, Dr. Voelcker found the drainage-water to contain 5·83 parts of nitrogen per 100,000 of water, corresponding to a loss of 13 lbs. of nitrogen per acre, per inch of rain so passing.

7. Owing to the much less loss by drainage in the case of spring than of winter sowing, there was not only more increase in the immediate crop from a given amount of nitrogen applied in the spring for barley (or oats) than in the autumn for wheat, but there was also much more effect upon succeeding crops, from the at first unrecovered amount, in the case of the barley than in that of the wheat.

8. It is probable that the whole of the nitrogen supplied as manure in ammonia-salts, or nitrate of soda, is either recovered in the immediate increase of crop, retained in the soil in a very slowly available condition, or drained away and lost.

9. Owing to the slow decomposition of the nitrogenous organic matter of rape-cake and farmyard manure, their nitrogen is less rapidly available than that of ammonia-salts or nitrate of soda; but, so far as can be judged from the direct experiments on the point, it would appar to be, at the same time, less subject to loss by drainage.

10. Certain important mineral or ash-constituents of manures

—potass, and phosphoric acid, for example—are, at any rate in the case of the heavier soils, almost wholly retained by them within the range of the roots; and they are found to be very lasting in their effects upon succeeding crops, provided there be a sufficient available supply of nitrogen within the soil.

Section V.—Results obtained in other Fields, and under other conditions as to Cropping, Manuring, &c.

Before attempting to give a general summary of the results of the experiments on the growth of barley for 20 years in succession on the same land, or to draw any general or practical conclusions from them, it will be well to call attention to some results obtained in other fields, and under different, and in some cases less artificial, conditions as to cropping, manuring, &c. By the aid of the comparisons thus afforded, some judgment may be formed as to whether any conclusions drawn from the results obtained under the unusual conditions of the experiments which have been detailed, may be trusted as a guide to the requirements of the crop when grown on other land, or in the ordinary course of farming.

Two sets of experiments will be noticed. In the first of these, barley was grown for 3 years in succession on a series of plots which had previously been differently manured, and grown 10 crops of turnips in succession. In the other case, barley has been grown in four-course rotation, without manure, and with different descriptions of manure.

1. *Three Years of Barley after Ten Years of Turnips—Barn Field.*

The results of these experiments were considered in some detail in our former paper on the Growth of Barley (vol. xviii., Part II., 1858), and they will therefore be referred to less fully in this place.

For the turnips, the area of from 7 to 8 acres was divided into numerous plots, differently manured; and the object in view in afterwards taking 3 unmanured barley-crops from the land was to test the actual and comparative condition for corn-growing, in which the different plots had been left, and, as far as possible, to equalize their condition (especially so far as the nitrogen which had been supplied was concerned), before commencing a new series of turnip experiments.

The turnips were grown in the 10 years 1843–1852 (Norfolk Whites 6 years, Swedes 4 years). In Table XLVIII. (p. 355) is given the produce of barley in 1853, 1854, and 1855, on plots manured for the turnips as under :—

1. A series of plots having various purely mineral manures during the last 8 of the 10 years of the turnips.

2. Plots having the same mineral manures as 1, during the last 8 years, and ammonia-salts (an average of 45 lbs. of nitrogen per acre per annum) during the first 6 of the last 8 years, namely 1845-1850 inclusive.

3. Plots having the same mineral manures during the last 8 years as 1 and 2, and, in addition, an average of nearly 17 cwts. rape-cake (= 90 lbs. nitrogen) per acre, per annum, during the first 6 of the last 8 years.

4. Plots having the same mineral manures as 1, 2, and 3, during the last 8 years, and both the ammonia-salts (=45 lbs. nitrogen), and the rape-cake (=90 lbs. nitrogen), per acre, per annum, during the first 6 of the last 8 years.

There is also given in the Table the produce of barley in 1854 and 1855, on—

5. A portion of the previously mineral-manured turnip-land, dressed for the barley-crop of 1854 with ammonia-salts, at the rate of 400 lbs. per acre (= 82 lbs. nitrogen); but without further manure in 1855.

6. Another portion of the previously mineral-manured turnip-land, dressed with nitrate of soda, at the rate of 550 lbs. per acre (= 82 lbs. of nitrogen), for the barley-crop of 1854, and of 112 lbs. (=17 lbs. of nitrogen), for the crop of 1855.

The average produce of turnips over the last 8 years (1845–1852) was :—

	1. With Mineral Manure, alone.		2. With Mineral Manure, and Ammonia-salts.		3. With Mineral Manure, and Rape-cake.		4. With Mineral Manure, Ammonia-salts, and Rape-cake.	
	Tons.	Cwts.	Tons.	Cwts.	Tons.	Cwts.	Tons.	Cwts.
Roots	7	9	10	$4\frac{3}{4}$	10	$19\frac{5}{8}$	12	$3\frac{7}{8}$
Leaves..	1	$10\frac{5}{8}$	3	3	2	$13\frac{1}{4}$	4	$7\frac{3}{8}$
Total	8	$19\frac{5}{8}$	13	$7\frac{3}{4}$	13	$12\frac{7}{8}$	16	$11\frac{1}{4}$

Thus, with purely mineral manures the produce was but small; with mineral manure and ammonia-salts it was more; with mineral manure and rape-cake again rather more; and with mineral manure, ammonia-salts, and rape-cake, together, it was the heaviest, but still, on the average, only about $12\frac{1}{5}$ tons of roots, and $4\frac{2}{5}$ tons of leaves, per acre per annum. On some portions the mineral manures supplied more of all the mineral constituents than were removed in the turnip-crops, but on others they did not; yet, there was so little difference in the subsequent produce of barley on the different mineral-manured plots, that only the average of all is given in each case in the Table.

For comparison with the produce of barley after turnips, there is also given in the top line of each division of the Table XLVIII. (p. 355), that without manure in the same seasons (which were the second, third, and fourth of the 20), in the field in which the crop has now been grown for so many years in succession.

The figures show that, over the three years, there were obtained after the mineral-manured turnips, an average of only 20 bushels of barley grain, and not quite 12 cwts. of straw, per acre per annum ; or not two-thirds as much as without manure after barley, clover, wheat, barley, and barley, in the same seasons, in the field in which the crop is now being grown continuously.

If, as has been maintained on high authority, the increased produce of corn which is obtained in rotation, is due to the accumulation, or elaboration, during the growth of other crops, of the mineral constituents required for the corn, it might surely be expected that, after a series of mineral-manured turnip-crops, for which, on some of the plots, more of every mineral constituent was supplied in the manure than was taken off in the produce, we should have full crops of barley. But what are the facts? We have after the mineral-manured turnips three perfectly insignificant barley-crops, and much less than when barley was grown after three immediately preceding corn-crops.

The question arises—in what constituent, or constituents, had the mineral-manured turnips so exhausted the soil as to bring it into a condition even far worse for the after growth of barley than when (after clover) three white straw crops had been grown in succession—namely, wheat without manure, barley with sulphate of ammonia, and barley without manure?

It is seen that where, besides the mineral manures, ammonia-salts (experiment 2), rape-cake (experiment 3), and ammonia-salts and rape-cake together (experiment 4), were applied annually during the first 6 of the last 8 years of turnips, there was more produce of barley, both corn and straw, than where the mineral manures had been applied alone ; and there was more where rape-cake, or ammonia-salts and rape-cake together, were employed, than where the ammonia-salts without rape-cake were used. The rape-cake not only supplied about twice as much nitrogen per acre as the ammonia-salts, but the nitrogen it contained would exist in a condition both less rapidly available and less liable to loss by drainage. The results obtained after the mineral-manured turnips (experiment 1) exclude the supposition that the increase of produce, where ammonia-salts had also been

TABLE XLVIII.—Three Years of Barley after Ten Years of Turnips.

BARN-FIELD.

PARTICULARS OF MANURES, &c.	Produce of Barley per Acre. 1853.	1854.	1855.	Average 3 Years.
Dressed Corn—Bushels.				
Hoos-Field—				
Barley, without manure, after 3 corn-crops	26	35⅛	34⅛	31⅜
Barn-Field—				
Barley, after 10 yrs. Turnips manured as under—				
1 Mineral manures (last 8 years)	20½	19½	20	20
2 Mineral manures (8 yrs.); Ammonia-salts (6 yrs.)	23⅛	21¼	21¾	22
3 Mineral manures (8 yrs.); Rape-cake (6 yrs.)	28¾	24⅝	23⅛	25¾
4 Mineral manures (8 yrs.); Ammonia-salts and Rape-cake (6 yrs.)	29⅛	23¾	23¾	25⅝
5 Mineral manures (8 yrs.); Ammonia-salts, for Barley, 1854 ..	(20½)	52⅜	26⅝	39½
6 Mineral manures (8 yrs.); Nitrate soda, for Barley, '54 & '55	(20½)	54⅞	40⅜	47⅝
Straw (and Chaff)—Cwts.				
Hoos-Field—				
Barley, without manure, after 3 corn-crops	17¼	22⅛	17⅞	19¼
Barn-field—				
Barley, after 10 yrs. Turnips manured as under—				
1 Mineral manures (last 8 years)	12¾	12½	10⅛	11¾
2 Mineral manures (8 yrs.); Ammonia-salts (6 yrs.)	13¾	13⅝	10½	12⅝
3 Mineral manures (8 yrs.); Rape-cake (6 yrs.)	17	15⅞	12⅝	15⅛
4 Mineral manures (8 yrs.); Ammonia-salts and Rape-cake (6 yrs.)	16¾	16	11⅜	14¾
5 Mineral manures (8 yrs.); Ammonia-salts, for Barley, 1854 ..	(12¾)	39⅛	12¾	25⅞
6 Mineral manures (8 yrs.); Nitrate soda, for Barley '54 & '55 ..	(12¾)	42⅝	22	32⅜
Total Produce (Corn and Straw)—lbs.				
Hoos-Field—				
Barley, without manure after 3 corn-crops	3467	4462	3923	3951
Barn-Field—				
Barley, after 10 yrs. Turnips manured as under—				
1 Mineral manures (last 8 years)	2618	2474	2206	2432
2 Mineral manures (8 yrs.); Ammonia-salts (6 yrs.)	2864	2691	2331	2629
3 Mineral manures (8 yrs.); Rape-cake (6 yrs.)	3558	3171	2712	3147
4 Mineral manures (8 yrs.); Ammonia-salts and Rape-cake (6 yrs.)	3546	3136	2555	3079
5 Mineral manures (8 yrs.); Ammonia-salts, for Barley, 1854 ..	(2618)	7377	2852	5114
6 Mineral manures (8 yrs.); Nitrate soda, for Barley, '54 & '55	(2618)	8005	4727	6366

used, was due to any action that they might have in increasing the available supply of mineral constituents within the soil, or that the effects of the residue of rape-cake were attributable to the mineral constituents it supplied. There can, indeed, be no doubt that, in all three experiments, the increased produce of barley was due to an increased supply of available nitrogen within the soil where it had been applied in the manures for the turnips. Still, in neither case is there as much produce of barley as without manure in the other (Hoos) field, where the barley was grown after several previous corn-crops.

But experiments 5 and 6 afford conclusive evidence that it was of available nitrogen for the barley that the soil had become so exhausted by the growth of 10 successive crops of turnips.

Thus, in the second year of barley, 1854, those portions of the mineral-manured turnip-plots which were left without further manure (experiment 1) gave $19\frac{1}{2}$ bushels of corn, and $12\frac{1}{2}$ cwts. of straw, per acre; whilst a portion to which ammonia-salts, at the rate of 400 lbs. per acre, were applied (experiment 5), gave $52\frac{3}{8}$ bushels of corn, and $39\frac{1}{8}$ cwts. of straw; and where 550 lbs. nitrate of soda, containing about the same quantity of nitrogen as the ammonia-salts, was applied (experiment 6), there were obtained $54\frac{7}{8}$ bushels of corn, and $42\frac{5}{8}$ cwts. of straw. In fact, by the simple addition of ammonia-salts or nitrate of soda, from 3 to $3\frac{1}{2}$ times as much total produce (corn and straw together) was grown.

Though not shown in the Table, it may be mentioned as remarkable, that although the produce without manure was very different in the two fields, that obtained when a given amount of nitrogen in the form of ammonia-salts or nitrate of soda was applied was very nearly identical in the different fields. The conclusion is that, in both, the mineral constituents, though abundant, were unavailing in the absence of a sufficiency of available nitrogen, but that when this was superadded, the amount of growth and produce was dependent on the amount of its supply, and the characters of the season.

Lastly, in the third year of barley after turnips (1855), the Plot 5, which had received ammonia-salts in the previous year, gave about $6\frac{1}{2}$ bushels more corn, and $2\frac{1}{4}$ cwts. more straw, than the exclusively mineral-manured plots; and Plot 6, which again received nitrate of soda, but only in small quantity (112 lbs. per acre), gave more than twice as much of both corn and straw as the purely mineral-manured plots.

There is still evidence of another kind, which may be cited as showing that it was of available nitrogen that the turnips had rendered the soil so deficient for the after-growth of barley. It may be assumed that, on the average, between 25 and 30 lbs. of nitrogen would be annually removed from the Rothamsted soil by wheat or barley grown year after year without nitrogenous manure. But it is estimated that from the mineral-manured turnip-plots there were, over the 10 years, more than 50 lbs. of nitrogen per acre per annum removed. As, however, on some of the plots small quantities of ammonia-salts or rape-cake were applied in the first two years of the ten of turnips, it is, perhaps, more to the purpose to take the average over the last 8 years of turnips only; and this would show about 45 lbs. of nitrogen removed per acre per annum. An immaterial proportion of this might be due to the small amounts of nitrogenous manures applied in the first two years. Still, it may be assumed that about 1½ time as much nitrogen was removed from the land for 8, if not for 10 years, in succession, as would have been taken in an equal number of crops of wheat or barley grown without nitrogenous manure. No wonder, then, that considerably less barley has been grown in 3 years after a series of mineral-manured turnip-crops, than was obtained in another field after a less number of corn-crops.

The results obtained in Barn-field afford a striking illustration of the dependence of the turnip-plant on a supply of available nitrogen within the soil, and of its comparatively great power of exhausting it. They are also perfectly consistent with those in Hoos-field, in showing that mineral manures will not yield fair crops of barley, unless there be, within the soil, a liberal supply of available nitrogen. The results obtained under such very different conditions in the two fields are, in fact, strikingly mutually confirmatory.

2. *Barley in Four-Course Rotation of—Turnips, Barley, Clover or Beans, and Wheat—Agdell-Field.*

These experiments, which are still in progress, were commenced in 1848, so that the crop of 1871 was the twenty-fourth, and completed the sixth course. The produce of barley obtained in the first three courses was given in the paper above referred to, but it is now given, though in less detail for each course, for the six completed courses.

The area of about 2½ acres was divided into three equal portions. One-third has been left entirely unmanured from the commencement; one-third has been manured with superphosphate of lime * alone, once every 4 years, that is for the turnip-crop

* Quantities per acre, as under—

	Bone-ash.	Sulphuric Acid. (Sp. gr. 1·7).
	lbs.	lbs.
1st Course	100	100
2nd Course	160	120
3rd, 4th, 5th, & 6th Courses ..	200	150

commencing each course; and one-third, also for the turnip-crop only, with a complex manure, consisting of superphosphate of lime, salts of potass, soda, and magnesia, sulphate and muriate of ammonia, and rape-cake.*

From half of each of the three plots the whole turnip-crop (roots and tops) was removed; on the other half the roots were consumed on the land by sheep, and the uneaten leaves spread and ploughed in. In the first course clover was grown as the third crop; but in the second, third, fourth, fifth, and sixth courses, instead of clover, half of each plot was sown with beans, and the other half left fallow.

It would be out of place here, to describe the results obtained in these experiments on rotation, any more than is essential to explain the conditions under which the barley was grown. The results which will be noticed relating to that crop are only those obtained on the portion of each of the three plots from which the turnips were entirely removed, and on which, in the later courses, beans (not fallow) replaced the clover. The facts of chief importance in relation to the other crops are as to the quantity of turnips removed from the land before the growth of the barley. The average produce of turnips per acre over the first five courses (the crop failing in the sixth) was—

	Without Manure.		With Superphosphate alone.		With Mixed Manure.	
	Tons.	Cwts.	Tons.	Cwts.	Tons.	Cwts.
Roots	1	6¾	6	16½	12	2½
Leaves	0	10½	1	8	2	2½
Total	1	17¼	8	4½	14	5

Under each of the three conditions as to manuring, the produce of turnips was much less in the later than in the earlier courses. This was, probably, partly owing to the higher condition of the land, dependent on previous manuring and cropping, at the commencement of the first than of the subsequent courses; but it was partly due to the characters of the seasons. Indeed, in

* Quantities per acre as under—

	Bone-ash.	Sulphuric Acid.	Pearl-ash.	Sulphate Potass.	Sulphate Soda.	Sulphate Magnesia.	Sulphate Ammonia.	Muriate Ammonia.	Rape-cake.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1st Course	100	100	100	..	..	..	100	100	1000
2nd Course	160	120	..	300	100	100	100	100	2000
3rd, 4th, 5th, & 6th Courses	200	150	..	300	200	100	100	100	2000

1868, the first year of the sixth course, turnip-seed was sown twice, but entirely failed, owing to the dryness of the season; and the land was then ploughed up, and left fallow for the barley.

The result in regard to the turnips may be stated in general terms as follows :—

Without manure there was scarcely any produce of turnips at all; there was, therefore, no exhaustion of the land by the removal of the crop; and it was, practically speaking, left fallow for the barley.

With superphosphate of lime alone only small crops of turnips were grown, especially in the later courses; still, much more was removed from the land than without manure; and, as nothing was supplied besides what the superphosphate itself contained, the land was, so far as other constituents are concerned, left in a much more exhausted condition for the growth of the barley than without any manure whatever.

With the mixed manure fair crops of turnips were removed in the earlier, but less in the later courses; and (excepting in the first year) there would remain in the land a considerable residue from the manures applied, and hence it would be left in a higher condition for the barley than after either the unmanured or the superphosphated turnips.

The produce of barley, under each of the three conditions as to manuring for the turnips, in each of the six successive courses, and on the average of the six courses, is given in Table XLIX. (p. 360); and, for comparison, there is also given, in the top line of each division, the produce, without manure, in the same seasons, in the field in which barley is grown year after year on the same land.

It will not be necessary to go into any detail respecting the produce of the individual years any further than to notice the apparently anomalous results of the first year. The much higher produce of barley after the unmanured than after the mixed-manured turnips, may be partly owing to some irregularities in the condition of the land at the commencement; but it is, doubtless, chiefly due to the fact that there had been removed from the unmanured plot only about $3\frac{1}{4}$ tons of roots, and $2\frac{1}{4}$ tons of tops, and from the mixed-manured plot nearly 11 tons of roots, and more than $7\frac{1}{2}$ tons of tops; whilst, as the foot-note at p. 358 will show, the mixed manure was much less liberal for the first than for the subsequent courses. There was, in fact, not only very much more turnips removed from the manured than from the unmanured plot, but there would be much less residue of manurial constituents, if any, left for the barley of the first course, than for that of either of the subsequent courses.

TABLE XLIX.—Barley in Four-course Rotation of—
Turnips, Barley, Clover or Beans, and Wheat.

PARTICULARS OF MANURES, &c.	PRODUCE OF BARLEY PER ACRE.						
	1849.	1853.	1857.	1861.	1865.	1869.	Average.
Dressed Corn—Bushels.							
Hoos-Field—							
Barley, unmanured, after 3 Corn crops		26	$30\frac{1}{2}$	$16\frac{1}{2}$	$19\frac{1}{2}$	15	$21\frac{1}{2}$
Agdell-Field—							
Barley, in Four-course Rotation—							
Unmanured, continuously	$44\frac{7}{8}$	$34\frac{3}{8}$	$48\frac{1}{2}$	$38\frac{5}{8}$	39	$24\frac{5}{8}$	$38\frac{3}{8}$
Superphosphate, for turnips only	$29\frac{7}{8}$	$28\frac{5}{8}$	$28\frac{1}{2}$	$30\frac{5}{8}$	$33\frac{1}{4}$	$28\frac{3}{4}$	$29\frac{7}{8}$
Mixed Manu.e, for turnips only	$28\frac{7}{8}$	$38\frac{1}{4}$	48	$60\frac{5}{8}$	$47\frac{1}{2}$	$42\frac{7}{8}$	$44\frac{3}{8}$
Straw (and Chaff)—Cwts.							
Hoos-Field—							
Barley, unmanured, after 3 Corn-crops		$17\frac{1}{4}$	$14\frac{1}{2}$	$10\frac{3}{8}$	$8\frac{3}{8}$	$10\frac{3}{8}$	$12\frac{1}{8}$
Agdell-Field—							
Barley, in Four-course Rotation—							
Unmanured, continuously	$26\frac{5}{8}$	$21\frac{3}{4}$	$23\frac{1}{4}$	$22\frac{1}{2}$	$19\frac{1}{4}$	$17\frac{3}{8}$	$21\frac{3}{4}$
Superphosphate, for turnips only	$18\frac{7}{8}$	$16\frac{3}{4}$	$13\frac{1}{8}$	$17\frac{7}{8}$	$14\frac{3}{8}$	$18\frac{1}{8}$	$16\frac{1}{2}$
Mixed Manure, for turnips only	$18\frac{5}{8}$	$23\frac{1}{4}$	$21\frac{3}{4}$	$35\frac{1}{8}$	$23\frac{1}{8}$	$29\frac{1}{2}$	$25\frac{1}{4}$
Total Produce (Corn and Straw)—lbs.							
Hoos-Field—							
Barley, unmanured, after 3 Corn-crops		3467	3295	2107	2042	2016	2585
Agdell-Field—							
Barley, in Four-course Rotation—							
Unmanured, continuously	5656	4465	5337	4718	4182	3358	4619
Superphosphate, for turnips only	3841	3560	3076	3775	3394	3686	3555
Mixed Manure, for turnips only	3794	4873	5168	7391	5148	5800	5363

It has already been shown that the produce of barley was much less after 10 turnip-crops—the last 8 with mineral manures only—than after 3 preceding corn crops; but, as the top line in each of the divisions of the Table (XLIX.) shows, the produce grown year after year on the same land without manure declined considerably in the later years. It is now seen that the quantity of barley grown in rotation without manure, is very considerably greater than that grown in succession without ma.ure. The produce is, indeed, considerably higher when grown in rotation after unmanured, than after superphosphated turnips. This is accounted for by the fact already stated, namely, that as scarcely any turnips were removed fiom the unmanured plot, the land was practically left fallow for the barley; whilst, from the superphosphated plot, the quantity removed would considerably exhaust the land.* Again (omitting the first year), the produce after the removal of the full-manured and larger crops of turnips was uniformly, and on the average, very much higher than after the removed superphosphated turnips, and also generally, and on the average, higher than after the unmanured turnips. This larger produce of barley after the removal of the larger crops of turnips grown by the mixed manure, is doubtless due to the fact that there would still be a considerable residue of the manure left within the soil.

It has already been shown, both by the results of the growth of barley year after year on the same land, and by those of its growth after the removal of a series of mineral-manured turnip-crops, that a liberal supply of mineral constituents alone is insufficient to secure a fair crop of barley. In both sets of experiments it was also shown that the further addition of nitrogenous manure raised the produce to a maximum. It might safely be concluded, therefore, that the larger produce of barley after the full manured, than after the superphosphated or the unmanured turnips in rotation, was not attributable to any residue of mineral constituents alone which would be left after the removal of the highly manured roots; and that the larger produce after the unmanured than after the superphosphated turnips was not due to a less exhaustion or greater accumulation of available mineral constituents where the smaller crop of turnips was removed.

But other evidence is not wanting to confirm the conclusion that the higher produce of barley after the unmanured than after the superphosphated turnips in rotation, and the higher produce still after the full-manured than after the unmanured turnips, were each due, in great part, to an accumulation of available nitrogen within the soil for the barley. Thus, it is estimated that, from the superphosphated plot, which yielded the smallest produce of barley, the turnips would probably, on the average of the five seasons in which they grew, remove about 50 lbs. of nitrogen per acre, or more than would be supplied in 200 lbs. ammonia-salts. From the unmanured plot they would remove only from one-fourth to one-third as much; and much less than would be contained in the increased produce of a corn-crop that would result from the fallowing of the land; so that, presumably, there would remain a considerable available store for the barley. From the mixed-manured plot, again, though the turnip-crop of the first course most probably removed considerably more

* The larger produce of barley on the superphosphated than on the unmanured plot in 1869 is only apparently an exception; for, as has been stated, the turnips failed in 1868, and there was, therefore, nothing removed from either plot in that year.

nitrogen than was supplied in the manure, the average produce of the subsequent courses would appear, by calculation, to have removed much less than was supplied; and, as most of that which was supplied was in the form of rape-cake, there would doubtless be an effective residue left within the soil.

To sum up the results on the point:—As in other experiments, so also in these, in which barley was grown in rotation, and under three very different conditions as to manuring, the evidence is sufficiently conclusive, and, therefore, corroborative of that in the other cases, that an essential condition for the growth of a full crop of barley, whether in rotation, or under less usual conditions, is a liberal supply of available nitrogen within the soil.

Section VI.—Summary and General Conclusions, showing the Practical Bearings of the Results.

In a former paper it was shown, that wheat had been successfully grown for twenty years in succession on the same land; that the produce without manure had, during that period, diminished comparatively little; and that that by farmyard-manure, and by certain artificial manures, had increased considerably. The thirtieth wheat crop is now growing, and shows no deterioration, in either quantity or quality, where the proper manures, natural or artificial, have been supplied. The most prominent result was, and still is, that mineral manures alone increase the produce scarcely at all; that nitrogenous manures alone increase it very considerably; but that the largest crops are obtained when nitrogenous and mineral manures are applied together.

How far do the results now recorded in regard to *barley* accord with those which have been obtained with its botanical ally—wheat?

The results on the growth of barley, without manure, by farmyard manure, and by a great variety of artificial mixtures, each used for twenty years in succession on the same land, have been given in detail in the foregoing pages; and they have been compared with those obtained with wheat under corresponding conditions. They have been classified, and given in separate sections, and at the conclusion of the sections they have been more or less formally summarised. It remains to call attention here to the most prominent results of the inquiry as a whole, with as little reference to detail as may be consistent with clearness, referring the reader to the detailed discussion of individual points, and to the summaries, given at the conclusion of preceding sections, for any further illustration or confirmation that may be needed.

The twenty-second crop of barley in succession is now growing, in a field immediately adjoining that devoted to the experiments on wheat, and having a soil and subsoil of similar general characters, namely, "a somewhat heavy loam, with a subsoil of raw yellowish-red clay, but resting in its turn upon chalk, which provides good natural drainage." It is obvious that, in wet seasons, such a soil is not well suited for the growth of the crop after roots fed on the land by sheep, as is the custom of the locality; but the results which have been recorded abundantly prove that, when grown under favourable conditions, large crops of barley, of good quality, may be obtained from such land.

Without manure, the average produce of barley, over twenty years, was 21 bushels of dressed corn, of $52\frac{1}{3}$ lbs. per bushel, and 12 cwts. of straw. The quantity fell off considerably, but the quality was considerably higher over the second than over the first ten years. Compared with wheat without manure, barley gave more corn, less straw, but nearly the same quantity of total produce; it, however, fell off more in produce of grain, and about equally in straw, over the later years.

By Farmyard manure, the average annual produce was more than 48 bushels of dressed corn, of $54\frac{1}{3}$ lbs. per bushel, and 28 cwts. of straw. The quantity of both grain and straw, and the quality of the grain, were considerably higher over the second than over the first ten years. As without manure, so with farmyard manure, barley, compared with wheat, yielded more corn, less straw, but much about the same quantity of total produce.

Mineral manures alone gave very poor crops; and the quantity of both corn and straw fell off considerably during the later years. With barley there was much more grain, rather less straw, but considerably more total produce than with wheat.

Nitrogenous manures alone gave much more barley than mineral manures alone; the produce declined much less in the later years; and, for twenty years in succession, fair, though not full, crops were obtained.

Nitrogenous and mineral manures together gave, for twenty years in succession on the same land, rather more of both corn and straw than farmyard manure, considerably more than the average barley crop of the country under rotation, and an average weight per bushel of between 53 and 54 lbs. With the same amount of nitrogen, and the same mineral manure, applied for twenty years, in the autumn for wheat, and in the spring for barley, the barley gave much more corn, more straw, and nearly one-third more total produce than the wheat.

Thus, then, with barley as with wheat, mineral manures alone failed to enable the plant to obtain sufficient nitrogen and carbon to yield even a fair crop. The greater effect of nitrogenous manures alone showed that the soil, in its practically corn-exhausted condition, was relatively richer in available mineral constituents than in available nitrogen. And the generally greater effect by nitrogenous and mineral manures together, than by farmyard manure—which contained not only very much more nitrogen, but a large amount of decomposing carbonaceous organic matter, and probably more of every mineral constituent than the crop—showed that the nitrogen of the farmyard manure was in a far less rapidly available condition, and that its supply of carbon was at any rate unessential.

It is hardly necessary to add, that the field results with barley, equally with those with wheat, are entirely inconsistent with the *mineral theory* so long in controversy, according to which—fertility was quite independent of the ammonia conveyed to the soil ;—if only the necessary mineral constituents were supplied in sufficient quantity and in available form, our cultivated plants, graminaceous as well as leguminous, would derive sufficient ammonia from the atmosphere ;—the presence of ammonia in our manures was immaterial; and—the entire future prospects of agriculture depended upon our being able to dispense with ammonia in our manures, therefore with animal manures.*

It is a very remarkable and very significant fact, that not only by farmyard manure, but also by artificial manures containing no carbon, an average of not far short of 50 bushels of barley-grain (or more if reckoned at only 52 lbs. per bushel), and nearly 30 cwts. of straw, or much more than the average crop of the country under rotation, should have been obtained by the growth of the crop year after year on the same land for twenty years in succession. Not only was such an average obtained over the twenty years, but there was even rather more corn, higher quality, only little less straw, and nearly identical total produce (corn and straw together), over the second compared with the first ten years, showing that, hitherto at least, there is practically no exhaustion by the continuous growth of such large crops under such conditions of soil and manuring.

It was with farmyard manure, however, the annual use of which has resulted in a very great accumulation within the soil, of nitrogen, of carbon, and probably of every mineral constituent also, that there has been the greatest increase of produce, and especially of corn, over the second as compared with the first ten years. On the other hand, without manure, with mineral manure alone, and with ammonia-salts alone—that is, with defective soil conditions—there was a considerable deficiency of both corn and straw over the second half of the period; the greater deficiency the more defective the manuring, and the greater the relative

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* For further remarks on the present position of the mineral theory controversy, see pp. 90–91 and 98–100.

deficiency of nitrogen in the soil; for the falling off was considerably more marked with mineral manure alone, than with ammonia-salts alone.

It will be obvious that an average of 50 bushels of barley-grain, and 30 cwt. of straw, would not be maintained without great fluctuations from year to year, according to season. Indeed, in no two years of the twenty did one and the same manure yield precisely the same result both as to the quantity and the quality of its produce; nor were the seasons which were more or less favourable than the average for one description of manure equally favourable for other descriptions. Thus, comparing the least and the most productive seasons of the twenty, there were obtained (reckoning the total corn at 52 lbs. per bushel)—without manure $15\frac{1}{2}$ and $37\frac{3}{4}$ bushels, or a difference of 22 bushels; with farmyard manure, 32 bushels and 60 bushels, or a difference of 28 bushels: lastly, with the two most productive artificial manures, there were obtained $30\frac{3}{4}$ and $36\frac{1}{4}$ bushels in the worst season, and 66 and 68 bushels in the best season, or a difference in favour of the good season of $35\frac{1}{4}$ and $31\frac{3}{4}$ bushels of grain. That is to say, with one and the same expenditure for manure, there was a difference in the quantity of the produce obtained in the two seasons, of from nearly 32 to over 35 bushels of corn, besides, in one case, nearly a ton of straw.

Not only, then, has the average produce over twenty years, by artificial, nitrogenous and mineral, manures, considerably exceeded the average barley crop of the country with rotation, but the difference between the produce by one and the same manure in the least and the most favourable seasons of the twenty was, itself, not much less than would represent the average barley crop of many localities.

As we have in substance frequently said, it is but a truism to assert that the growing plant must have within its reach a sufficiency of the mineral constituents of which it is to be built up. But the results obtained with barley, as well as those with wheat, have shown that, whilst it is essential that there be a liberal provision of mineral constituents within the soil, the amount of produce is more dependent on the supply by manure of available nitrogen than of any other constituent.

The practical question obviously arises—How much ammonia, or its equivalent of nitrogen in some other form, will, on the average, be required to yield a given amount of increase of wheat or barley grain, and its proportion of straw?

In our Report on the growth of wheat for twenty years in succession on the same land, it was shown that the quantity of increase obtained for a given amount of ammonia, or its equivalent of nitrogen, in manure, varied exceedingly according to the *amount applied*, to the *provision of mineral constituents within* *the soil*, and to the *seasons*. It was, however, stated, as a general practical conclusion, that, under the conditions the most comparable with those of ordinary practice, approximately 5 lbs. of ammonia, or its equivalent of nitrogen, were, on the average, required to yield 1 bushel increase of wheat, and its proportion of straw.

In like manner the experiments with barley have shown a very wide variation in the amount of ammonia required to yield a given quantity of increase, according to the *amount applied*, to the *provision of mineral constituents within the soil*, and to the *seasons*.

Thus, with superphosphate and 200 lbs. of ammonia-salts per acre per annum, for six years, 3·26 lbs., but with 400 lbs. 5·06 lbs. of ammonia were required to produce 1 bushel increase of barley-grain and its straw.

Again, with 200 lbs. of ammonia-salts for twenty years, there were required—on three plots where it was used with superphosphate 2·13, 2·41, and 2·10 lbs.; on one plot where it was used with salts of potash, soda, and magnesia, without superphosphate, 3·59 lbs.; and on one without any mineral manure at all, 3·68 lbs. of ammonia to yield 1 bushel of barley and its straw.

Lastly, with only 200 lbs. of ammonia-salts per acre per annum, and with superphosphate also applied, the difference in the amount of ammonia required to yield 1 bushel of increase was, according to *season*, from about 1½ lb. in the two most favourable, to 5·36 and 4·48 lbs. in the two least favourable seasons; whilst, with only the same moderate amount of ammonia-salts, but used without superphosphate, or without any mineral manure at all, the difference in result according to season was very much greater still.

Notwithstanding these very considerable and very significant variations, it may be concluded, from a review of the whole of the data bearing on the point, that when an increase of barley is obtained by means of artificial manures, such as salts of ammonia, nitrate of soda, or Peruvian guano, an increase of 1 bushel of grain, and its straw, may, taking the average of seasons, be calculated upon for every 2 to 2¼ lbs. of ammonia (or its equivalent of nitrogen, 1·65 to 1·86 lbs.) supplied in the manure —provided the quantity applied be not excessive, and there be no deficiency of mineral constituents within the soil. When, however, rape-cake is used, rather more nitrogen in that form will be required to yield a given increase; but when the increase is obtained by sheep-folding, or by farmyard manure, very much less increase will be yielded in the year of the application, in proportion to the nitrogen contained in the manure.

Thus, whilst it was concluded that, on the average, about 5 lbs. of ammonia (or its equivalent of nitrogen) were required to yield 1 bushel of increase of wheat, and its proportion of straw, it is now assumed that only 2 to 2¼ lbs. of ammonia are required to produce 1 bushel increase of barley, and its straw. But whilst an average bushel of wheat may be reckoned to weigh 61 lbs., and its average proportion of straw 105 lbs., an average bushel of barley will weigh only 52 lbs., and its straw only 63 lbs. Hence, whilst it required 5 lbs. of ammonia in manure to yield 61 lbs. of wheat-grain, and 105 lbs. of straw = 166 lbs. of total produce, it only requires from 2 to 2¼ lbs. to yield 52 lbs. of barley-grain and 63 lbs. of straw = 115 lbs. of total produce. In other words, for the production of 100 lbs. increase of total produce of wheat, it required 3 lbs., and for the production of 100 lbs. increase of barley (containing a larger proportion of grain, but about the same amount of nitrogen) it required only from about 1¾ to 2 lbs. of ammonia in manure. That is to say, it required much more ammonia to yield a given amount of increase when applied in the autumn for wheat, than when in the spring for barley.

The following questions obviously suggest themselves:—

What proportion of the nitrogen supplied in manure will probably, on the average, be recovered in the increase of the crop for which it is applied?

Will the at first unrecovered amount have any marked effect on the immediately or early succeeding crops?

Will there be any residue retained by the soil and the subsoil, in such a state of combination, and distribution, as only to be yielded up, if ever, in the course of a long series of years?

Will there be any drained away and lost?

Lastly, will the answers arrived at on these points, in regard to wheat or to barley, be equally applicable to both crops?

With regard to the proportion of the nitrogen of artificial manures recovered in the increase of crop obtained by their use, in former papers it has been estimated, taking the average over a comparatively limited number of years, that about 40 per cent. was recovered in the increase of wheat, of barley, and of meadow-hay indifferently. But, by the aid of numerous new determinations of nitrogen in the produce of wheat for twenty years, of barley for twenty years, and of oats for three years, it now appears that, with the same mixed mineral manure in each case, and the same amount of ammonia-salts applied in the autumn for wheat, and in the spring for barley and for oats, rather less than one-third of the supplied nitrogen has been recovered in the increase of the wheat, but nearly one-half in that of the barley and the oats. When, however, there were applied, even for wheat, the same mineral manure and nitrate of soda, the latter sown in the spring, a not much less proportion of its nitrogen was recovered in the increase of the crop, than in the case of the ammonia-salts applied for barley in the spring, or of the ammonia-salts or nitrate of soda applied for oats in the spring.

Not only, then, did a given amount of nitrogen, supplied as ammonia-salts, yield much more increase of produce in the years of its application, when applied in the spring for barley than when in the autumn for wheat, but a larger proportion of it was recovered in the increase of the spring-sown crop.

The field experiments have further shown, that the at first unrecovered amount yielded scarcely any increase at all in succeeding years in the case of the wheat, but a considerable increase in that of the barley.

With both crops, however, there remained a considerable amount of the supplied nitrogen not recovered in either at the first or the early succeeding increase of produce; but there is obviously very much more to be otherwise accounted for in the case of the autumn-sown wheat than of the spring-sown barley.

With regard to retention by the soil, the results of the analysis of samples of the soils of many of the differently manured plots in the experimental wheat-field, taken in all down to a depth of 27 inches, showed that a considerable amount of the nitrogen which had been supplied in the manure, and not recovered in the increase of crop, was accumulated within the soil; but it was concluded that a larger proportion remained unaccounted for to the depth examined, than was there traceable, and that some of this had passed off by the drains, and some into the lower strata of the subsoil.

With regard to loss by drainage, numerous analyses, by Dr. Voelcker and Dr. Frankland, of the drainage waters from the Rothamsted experimental wheat-plots, confirmed the supposition that there had been a considerable loss of the nitrogen of the manures in that way. They showed that the quantity of nitrates in the drainage-water was the greater the greater the amount of ammonia-salts applied; and that, after autumn-sowing, the quantity was very much greater in the winter than subsequently in the spring and summer.

Calculation showed that, for every 1 part of combined nitrogen per 100,000 parts of drainage-water, there will be a loss of $2\frac{1}{4}$ lbs. of nitrogen per acre for every inch of rain passing beyond the reach of the roots as drainage of that strength. In one case of winter-drainage, after an application of 600 lbs. of ammonia-salts per acre in the autumn, Dr. Frankland's analysis showed 7·841 parts of nitrogen per 100,000 parts of water, corresponding to a loss of nearly 18 lbs. of nitrogen per acre, provided (which, however, is not probable) that an inch of rain had passed as drainage of that strength.

As would be expected, as the nitrate of soda was, even for wheat, always sown in the spring, the autumn and winter-drainage from the nitrated plot always contained much less nitrogen than that collected at the same date from the plots manured with ammonia-salts in the autumn. Owing, however, to the much less capacity of a given surface of soil for the absorption of nitrate of soda, or other nitrates arising from its decomposition, than of the ammonia of ammonia-salts, heavy rains, soon after sowing, would carry off more of the nitrogen from nitrate of soda than from a corresponding dressing of ammonia-salts. In one case Dr. Voelcker found, in the drainage collected from the nitrated plot soon after a dressing of 550 lbs. of nitrate per acre (= 400 lbs. ammonia-salts), applied in the spring, 5·83 parts of nitrogen per 100,000 parts of water, corresponding to a loss of about 13 lbs. of nitrogen per acre per inch of rain passing.

These facts, showing how great may be the loss of the nitrogen of manure by drainage, are obviously of the greatest practical importance, and demand very serious consideration.

Owing to the difficulty of determining with certainty, either the total amount of nitrogen retained by the soil within the reach of the roots, the proportion of the total rain which would pass beyond the reach of the roots, or the *average* composition of the drainage-water, absolute proof whether the whole of the supplied nitrogen which is not recovered in the crop is either retained by the soil, or lost by drainage, is not at command. Still, a consideration of such data as are available in reference to the points here indicated, points to the conclusion that the whole of the nitrogen which was applied as ammonia-salts or nitrate of soda to the wheat was either *recovered in the increase of crop*, *accumulated within the soil*, or *lost by drainage*.

As already said, as the proportion of the nitrogen of ammonia-salts which was recovered in the increase of produce was much greater in the experiments with barley than in those with wheat, there remained of course much less, in its case, to be accounted for by accumulation in the soil, and by drainage.

Only few determinations of nitrogen have as yet been made in the soils of the barley plots; but, so far as can be judged from the results obtained hitherto, it seems probable that there is less accumulation than in the case of the wheat, especially in the lower layers. It seems pretty certain, too, that there must be much less loss by drainage; but, as the experimental barley-field is not artificially drained, no direct evidence can be adduced on the point. It may be observed, however, that as the ammonia-salts are sown for the barley in the spring, when the soil is in a porous condition, when there is comparatively little risk of washing out, and when growth almost immediately succeeds, there will be a less immediate and wide distribution of the ammonia, or of the nitrate resulting from its oxidation, a larger proportion at once taken up by the growing crop, and, probably, a larger proportion fixed near the surface before the winter-rains, and remaining available there for succeeding crops.

Not only, then, do the results point to a satisfactory explanation of the loss of nitrogen which has been observed in the use of artificial nitrogenous manures, but also of the much greater loss when they are applied in the autumn for wheat, than when in the spring for barley or for oats. In confirmation of the explanation on the latter point, may be cited the facts that, not only was there on the average much more increase even of wheat, and much more nitrogen recovered in the increase, when a given amount of it was applied as nitrate of soda in the spring than when as ammonia-salts in the autumn, but the difference in favour of the spring-sown manure was especially marked after unusually wet autumns and winters.

There is another point to notice in connection with the action of nitrate of soda. A given surface of soil has much less power to retain either nitrate of soda, or other nitrates, than ammonia, and so far their nitrogen is, *cæteris paribus*, more liable to loss by drainage. Yet, when frequently used on the same land, such was the effect of the nitrate, or its products of decomposition, aided by increased development of root, in causing the disintegration, and so increasing the porosity and surface of the clay subsoil, that there would appear to have been not only a greater retention of moisture in an available form by the subsoil, rendering the growing crop more independent of drought, but also a greater retention of nitrates than would be anticipated considering their solubility, and, hence, a more lasting effect from previous applications than would otherwise be expected. On the other hand, where, as in the case of the experiments at Rothamsted, nitrate of soda has been used in large quantities so many years in succession, the surface soil has retained so much moisture as to be difficult to work after wet weather.

The results have shown that a considerably less proportion of the nitrogen applied as rape-cake, than as either ammonia-salts or nitrate of soda, was recovered in the increase of crop within a given period of time, and again considerably less of that applied in farmyard manure than in rape-cake. Owing to the slow decomposition of the nitrogenous organic matter of these manures, their nitrogen is necessarily but slowly available. It would appear, however, to be, at the same time, less subject to loss by drainage; and analysis has shown that a large proportion of their nitrogen is retained by the soil, becoming but very gradually available for a considerable length of time. Indeed, analysis showed that where farmyard manure had been applied for wheat every year for twenty-five years in succession, the top 9 inches of soil contained nearly twice as high a percentage of nitrogen as the corresponding layers of any of the artificially manured plots, which, though they received much less nitrogen annually, as ammonia-salts or nitrate of soda, nevertheless yielded larger crops. Still, there is a large amount of the nitrogen of the dung not yet satisfactorily accounted for; but, whether there will be an ultimate loss of a greater or less proportion of that supplied, than when ammonia-salts or nitrate of soda is used, the data at present at command do not enable us to determine with certainty.

It is, then, established, that there is a great liability to loss by drainage of the nitrogen of manures, the available amount of which, more than of any other constituent, rules the amount of produce, under the existing conditions of British agriculture. The mineral constituents being, however, equally essential for growth, it is obviously important to have some direct experimental evidence showing whether or not they are also liable to such loss.

The field experiments with wheat have afforded conclusive evidence of the marked effect of potass and phosphoric acid supplied more than twenty years previously, when nitrogenous manures were afterwards applied to render them available; and, not only are the results of the analysis of the produce consistent with this, but the analysis of the soils has shown their accumulation, and that of the drainage-waters their comparatively little liability to loss in that way. Indeed, it may be concluded that, at any rate in the case of the heavier soils, these constituents, which, by the sale of corn and meat, would otherwise be the most likely to become relatively deficient, and which in that point of view are the most important to consider, are almost wholly retained within the reach of the roots.

Let it be granted—that, in one field at Rothamsted, wheat, and in another barley, have been grown for many years in succession, the same manure being applied to the same plot year after year; that, under these circumstances, it has been found that mineral manures alone have little or no effect, that nitrogenous manures alone have very much more, and that nitrogenous and mineral manures together will continue to yield as large crops as farmyard manure annually applied, and much larger than the average produce of the country under rotation. It may still be asked, whether conclusions drawn from results obtained under such unusual conditions may be trusted as any guide to the requirements of the crops when grown on any other land, or in the ordinary course of farming?

In our paper on the growth of wheat for twenty years in succession on the same land (vol. xxv., pp. 491–494), we adduced the results of direct experiments, made not only in another field at Rothamsted, but also in other localities, on soils of very different description, and in very different condition. The result in each case was, as in the experimental field, that there was but little increase by mineral manures alone, much more by ammonia-salts alone, and more still by ammonia-salts and mineral manure together. We further stated our conviction, founded on a very extensive acquaintance with the practical experience of farmers in the use of artificial manures in every district of Great Britain for many years, that, in 99 cases out of 100 in which wheat is grown in the ordinary course of agriculture with rotation, the supply of immediately available mineral constituents is in excess relatively to the immediately available supply of nitrogen.

In our former paper on the growth of barley, and again in Section V. of the present paper, evidence of a similar kind is adduced in regard to that crop. Two sets of experiments are quoted. In one, barley was grown for three years in succession on a series of plots which had previously been differently manured, and grown ten crops of turnips in succession. In the other, it was grown in four-course rotation, without manure, and with different descriptions of manure. The evidence of these other experiments is entirely confirmatory of the conclusion, that mineral manures alone will not yield fair crops of barley, and that an essential condition for the growth of full crops, whether in rotation or under less usual conditions, is a liberal supply of *available nitrogen within the soil.*

Further, as in the case of wheat, so also in that of barley, the common experience of the country at large, in the use of artificial manures to that crop, is entirely confirmatory of the conclusions to which the results of the experiments on its growth year after year on the same land would lead.

It may here be remarked, that the greater liability to loss by drainage of the nitrogen, than of the more important mineral constituents of manure, is doubtless one element in the explanation of the fact of the prevailing excess of available mineral constituents, relatively to available nitrogen, in soils generally, under the ordinary course of agriculture in this country.

Those who have examined for themselves the evidence that has been adduced, and carefully considered the conclusions that have been drawn in reference to the great number of points which the enquiry has opened up, will probably feel that they do not require any specific receipts to be laid down for their guidance, and that they will profit more by the direction which the study of the facts must give, to their own observation and reflections on what comes before them in the course of their daily experience. Indeed, under any circumstances, it must be left to the intelligence and the judgment of the individual farmer to decide upon the degree in which any special recommendations will be applicable to his own particular soil, and other circumstances.

Still, in bringing this long report to a conclusion, a few words should be offered by way of pointing out the more directly practical application of the results.

For twenty years in succession on the same land, an annual expenditure of less than *3l.* per acre in artificial manures has yielded an average produce of 6 quarters of dressed barley, of good quality, and nearly $1\frac{1}{2}$ ton of straw. Any practical farmer can estimate what would be the additional expense upon the crop, in the way of rent, cultivation, harvesting, bringing to market, &c.; and, having done so, the result will doubtless show a considerable profit.

The soil at Rothamsted is more suitable for wheat than it is for the growth of barley after roots, as is the common practice of the locality; but the facts show that it will nevertheless grow large crops, of good quality, under favourable circumstances. Indeed, it may be laid down as a general rule, applicable to the country at large, that, on the heavier soils, full crops of barley of good quality may be grown with great certainty after a preceding corn crop, under the following conditions:—

First of all, it is essential that the land be got into good tilth. It should be ploughed up when dry, as soon as practicable after the removal of the preceding crop. In the spring it should be prepared for sowing by ploughing or scuffling as early in March as possible, if sufficiently dry.

The artificial manure employed should contain nitrogen, as ammonia or nitrate (or organic matter), and phosphates.

From 40 to 50 lbs. of ammonia (or its equivalent of nitrogen as nitrate) should be applied per acre. These quantities would be supplied in—

$1\frac{1}{2}$ to 2 cwts. of sulphate ammonia, or
$1\frac{3}{4}$ to $2\frac{1}{4}$ cwts. of nitrate of soda.

With either of these there should be employed—

2 to 3 cwts. mineral superphosphate of lime.

Of late years the composition of Peruvian guano has been so variable and uncertain, that it is quite impossible to estimate how much of it would be required to supply nitrogen equal to from 40 to 50 lbs. of ammonia. It is impossible, therefore, under such circumstances, to recommend it. If, however, the agents of the Peruvian Government were to manufacture their guano into a substance of uniform quality, and to guarantee to deliver it of a stated composition, it would be quite otherwise; and, as the guano itself contains phosphates, if the ammonia required were purchased in that form, superphosphate need not be also employed.

Rape-cake is also a good manure for barley. From 6 to 8 cwts. would supply about as much nitrogen as would be equal to from 40 to 50 lbs. of ammonia. But, a smaller proportion of the nitrogen of rape-cake, than of sulphate of ammonia, nitrate of soda, or Peruvian guano, will be effective within a given time. In the experiments at Rothamsted about 9 cwts. of rape-cake per acre per annum, gave an average annual produce, over 14 years in succession, of 44 bushels of dressed corn, of nearly 55 lbs per bushel. With rape-cake, as with guano, the addition of superphosphate is unnecessary.

Whatever manure be used, it should be broken up, finely sifted, sown broadcast, and harrowed in with the seed.

Economy in the cost of the nitrogen is the essential point to be considered in the selection of the manure to be used. To enable the farmer to make an advantageous choice, according to the market price of the different manures at the time, it may be useful to state, as a basis of the calculation, that 1 cwt. of nitrate of soda, of the quality usually imported, contains nitrogen equal to 21 lbs. of ammonia; and if the nitrate cost 15*s*. 9*d*. per cwt., that will be equivalent to 9*d*. per lb. for ammonia, or 15*s*. per ton for every 1 per cent. of ammonia (or nitrogen equal ammonia) which the manure contains. According to the experiments at Rothamsted, it would appear that, at equivalent prices, a given amount of nitrogen as nitrate of soda may, in the long run, be more effective than an equal amount as ammonia; for, contrary to the current opinion, the full effect of the nitrate was not obtained until it had been used for some years on the same plot.

The liability to loss of the nitrogen of manure by drainage has been shown to be very great. It will, of course, vary very much, according to the characters of the soil and subsoil, and of the seasons. But as it is much greater during the late autumn and winter months, than in the spring and summer, nitrate of soda, sulphate of ammonia, or Peruvian guano, should always be sown in the spring;—for wheat as a top-dressing in March, and for barley, or oats, as described above.

By a more liberal application of manure per acre for the root-crop, the area devoted to it may be considerably reduced with comparatively little reduction in the amount of the crop on the farm as a whole. Barley might then be grown more frequently, with an increase of profit to the cultivator, and without lessening the renting value of the land.

Rothamsted, July, 1873.

XIII.—*Report on the Health of Animals of the Farm.* By Professor J. B. Simonds, Principal of the Royal Veterinary College.

In the interval which has elapsed since my last report, both cattle and sheep have been less affected by diseases of an ordinary type than is usually the case in the early part of the year, notwithstanding the coldness of the weather which has prevailed, and the general backwardness of the season. Special diseases also have been less rife, and notably the one commonly known as 'foot-and-mouth disease.' Early in the year this malady began to decline, both in severity and extent, in many parts of Great Britain and Ireland; and since then, with few exceptions, the decrease has been fully maintained. Legislative measures may possibly have contributed to this desirable end; but the history of the affection, as belonging to this country, clearly proves that, independently of any such means, 'foot-and-mouth disease' has been for long periods of time together so little prevalent as to attract scarcely any public attention. The outbreak, the decline of which we now record, commenced in the summer of 1869, and extended onwards to 1870–'71 and '72. Doubtless it has proved a most severe visitation; but those who are familiar with the extent and malignancy of foot-and-mouth disease in 1839–'40 and '41 recognise a parallel instance of its duration, acme, and decrease when no legislation existed with regard to it.

Cattle, sheep, and pigs, as is well known, are the chief victims of foot-and-mouth disease, but an opinion has recently prevailed that hares and rabbits are also the subjects of the malady. To test this belief some experiments were had recourse to at the College in April last. In the first instance two rabbits were inoculated with the contents of a vesicle which had formed in the mouth of a cow, and the detached epidermoid covering of a second vesicle, with a quantity of saliva, was also placed in their mouths and retained for a time. No effects followed. In the second instance, in addition to a similar inoculation of two other rabbits, the contents of several vesicles were well rubbed into the thin skin between their toes, but also without effect.

Another contagious disease has also been made the subject of experiment, viz., the small-pox of sheep. The facts prove beyond all doubt that some Saxony-merino or German sheep, bought by a butcher, gave indications of variolous disease prior to being slaughtered. A very small piece of skin, on which one or two minute vesicles existed, was forwarded to the College by a drover, who declined to give full information with regard to it, or from whom it had been procured. An examination satisfied me that the vesicles were those of variola, nevertheless it was determined to have recourse to the crucial test of inoculation. The vesicles were too far advanced, besides being remarkably small, to yield fluid virus, and consequently the inoculation was made with a minute portion of their epidermoid covering. The subject was a lamb; and four punctures were made—two on the inner side of each thigh. Two of the punctures took on the *fourth* day. The local effects continued to increase until the *seventh* day, when the animal sunk from the constitutional disorder which accompanied the development of the local symptoms.

The inoculation was made on April 30th, since which time anxious enquiries have been instituted for the purpose of ascertaining whether sheep-pox had again obtained a footing in the country, but happily to this time the enquiry has had a negative result. This case is probably but one of many which occur among German sheep, and it shows the absolute necessity of the greatest care being observed with regard to these animals when imported. Bought for slaughtering, the risk is reduced to a minimum; but no farmer should venture to buy these or other sheep for feeding which have been imported from Central or Eastern Europe.

Cattle Plague.—Since the introduction of this most malignant disease last year, by Russian and German cattle exported from Cronstadt and Hamburg, no case has been detected by the inspectors at any of the ports; nor is it known that the malady has penetrated further westward than Bohemia and Silesia. Eastern Europe has, however, continued to suffer to a great extent for many consecutive months, and, according to information received through official sources, Poland, Galicia, Hungary, and Lower Austria have not been free from the disease this year. The risk of the introduction of cattle-plague is doubtless increased in proportion to its extension westward; but experience has shown that the greatest danger belongs to the direct importation of Russian cattle, or to those which are brought *viâ* the Baltic into Western Europe.

Pleuro-pneumonia.—The accounts which come to hand from time to time with reference to pleuro-pneumonia would seem to show that the provisions of the "Contagious Diseases (Animals) Act," as administered in many parts of the country, have done little or no good in keeping the disease in check. To exterminate pleuro-pneumonia, not only more stringent, but more united, measures must be employed, and it is not unlikely that one beneficial result of the labours of the committee now sitting to enquire into the working of the Act will be the adoption of such measures, or the better administration of those now existing. Pleuro-pneumonia may probably not be found in more counties than at the beginning of the year, but recent information proves that the cases are increasing in number, and consequently the centres of infection augmenting.

Scrofula.—Judging from the number of specimens which have been forwarded to the College by veterinary surgeons residing in counties far distant from each other, this hereditary but non-contagious malady would appear to be not only wide spread, but also on the increase. One cause of this is doubtless a want of care in selecting animals which are to be used for breeding purposes. No animal which shows the least evidence of the disease, or which belongs to a family known to be affected, ought to be used as a stock animal. Scrofula can frequently be detected by the existence of tumours in various parts of the body of cattle, but they show a greater preference to form about the throat and sides of the face than elsewhere. These tumours, especially such which are hard or nodulated to the feel, and only slightly painful, cannot be completely dispersed by any kind of treatment, but after a time they often yield to a degenerating process, and discharge a purulent-like fluid from sinuses which are formed within them. The disease is met with in all kinds of cattle, but prevails to the greatest extent among those which are known as our improved breeds, or pedigree stock.

Splenic Apoplexy.—During the first months of the year very few cases of this disease came to our knowledge; but recently our attention has been called to two or three rather serious occurrences of the malady. The last of these took place in the neighbourhood of Hitchin among some heifers which were being grazed for the butcher. Several died very suddenly, and without any indications of ill-health being previously observed. Others sunk after an hour or two's illness. The veterinary surgeon at first suspected that the animals had been either accidentally or intentionally poisoned; but an examination of the viscera—abdominal and thoracic—which were forwarded to the College, clearly showed that the animals had died from that remarkable blood affection known as splenic apoplexy. It is a singular fact, that although some bullocks were being grazed in the same pasture, and separated only from the heifers by an iron fence, not one of them was attacked by the malady. A change of food and in the system of management, and the exhibition of antiseptic agents—such as the hypo-sulphite of soda—acted quickly in arresting the further progress of the malady.

Lead Poisoning.—On two occasions within the past few weeks, the assistance of the College has been required in consequence of the serious illness of two herds of cattle, and the death of several in each instance. One of these cases occurred in Hertfordshire, and the other in Sussex. In the former the herd numbered forty-one animals, all of which gave indications of disease, and nine of them died. In the latter the herd consisted of twenty-three animals, out of which five died. An investigation was made on the farm in each case, the Hertfordshire one coming first under notice. The symptoms presented by the animals were those which belong to poisoning by the compounds of lead.

It was found that the animals had been put to pasture on May 3rd, and that their illness was observed on the 12th. One died on the 13th, and the death of this was quickly succeeded by the others. Further investigation and a visit to the field showed that a portion of it had been manured in March with so-called London refuse manure. The grass had grown more luxuriantly on this part, and the animals had shown a preference to feed upon it. A search for deleterious matters resulted in finding large masses of dried paint among dirt and rubbish of all kinds, the clearing-out of London ash-heaps.

The Sussex case was precisely of the same kind, but in this instance the manure was not put on so early, and the animals were not turned out until May 23rd. At the end of nine days several were ill, and three died; a fourth died on June 12th, and a fifth on June 14th.

The opinion arrived at as to the animals being poisoned by the old paint, received a full confirmation by a chemical analysis of the contents of their digestive organs—the compounds of lead being found in great abundance.

Royal Veterinary College,
June 28, 1873.

XIV.—*On Climate and the Supply of Labour as affecting Agriculture in Ireland.* By W. Bence Jones, Lisselan, Co. Cork.

Mr. Pringle's interesting paper on 'Irish Agriculture' in a recent number of this Journal * leaves untouched, except by a passing mention, one part of the subject which I think deserves especial notice.

I allude to climate, which, in one of the ablest essays in the Journal (Whitley on the 'Climate of the British Isles,' vol. ii., p. i.), is well described as the ruling principle of agriculture.

The Irish climate is proverbially wet. A glance at the Rain-map of Europe in Keith Johnston's 'Physical Atlas' shows that, exclusive of exceptional mountain districts, the rainfall in Munster is the largest in Europe, a few small spots alone being equal to it. Whilst the rainfall in Essex and the East of England is about twenty inches, over forty inches is the average of Cork. The rainfall of the West of England and of the other three provinces of Ireland does not differ much—thirty to thirty-five inches. The rain increases down to Penzance, where it is the same as in Munster. Meteorological observations are kept at very few places in Ireland, and there is reason to believe that the local rainfall in many parts is much greater than any that has

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* Second series, vol. viii., Part I., No. xv. pp. 1–76.

been registered. It is certain that there is a dampness in the atmosphere, as shown in the effect on household goods, clothes, &c., and an absence of hot, dry weather in summer, especially in the South, much beyond anything usual in most parts of the West of England, even where the rainfall is the same. Arthur Young said, long ago, "The worst of the climate of Ireland is the constant moisture without rain." I am inclined to think it might be said more truly, The best of the climate is the constant moisture. But, either way, whether for good or bad, such is the climate. My experience has been chiefly in the West Riding, Co. Cork, and there, beyond a few warm days in summer, sometimes not more than half-a-dozen, we know very little of what hot weather means. In spite of this dampness of atmosphere, the soil being generally rather thin, and so drying very quickly, it is a charming climate, mild in winter and cool in summer, of a refreshing softness after the heat of English summer weather, that causes a sense of actual enjoyment from mere passing through the air, like that from a drive in the cool evening of a roasting day.

The one drawback is the force of the south-west winds, which are, however, the cause of our other advantages.

Facts from the garden confirm this opinion. Pears against a wall seldom ripen to their right flavour. Peaches, except in especially warm and sheltered places, will not do well. Peach-trees continue growing throughout the autumn. I have often seen them as full of leaves at Christmas as at Midsummer. Of course the wood does not ripen, and any frost kills this green wood, and often reduces the tree in the following summer to bare branches, with a tuft of green leaves at the end of each. Apricots hardly ever bear fruit.

Such a climate as this plainly must have a very great influence on farming; a greater influence probably than any other natural cause.

Mr. Buchan, President of the Botanical Society of Edinburgh, in his Address to the Society, November 9, 1871, thus speaks on the subject of the effects of climate on the distribution of plants:—

> Bousingault examined the distribution of wheat on the continent of Europe, and arrived at the conclusion that it required 8248° Fahr., from the time it begins to grow in spring, for the proper ripening of the seed; and, moreover, that this heat must be partitioned so as to secure a mean summer temperature of 58° during the development and maturation of the seed. This minimum amount of heat required for the maturing of the seeds is a vital consideration.* We have proved in Scotland that a mean temperature of 56° during the critical period, with the average sunshine and rainfall of the

* This subject has been alluded to in reference to Belgium in my report on the agriculture of that country, see 'Journal Royal Agricultural Society,' second series, vol. vi., Part I., No. xi. p. 4.—Ed.

Scottish summer, is sufficient to ripen wheat properly. Not only so, but it was found that the wheat crop of 1864 ripened well with only the average temperature of 54·4°. In that year, however, the sunshine was much above the average, and the mean of the daily maximum temperature was high, being as high as in August 1861, when the mean temperature was 57·4°.

It is probable that the longer time the sun is above the horizon in Scotland, as compared with Germany and France, renders the ripening of this cereal possible with a lower mean temperature, and when this is combined with a clear dry atmosphere, and consequently a blazing, scorching sunshine, grain of excellent quality is ripened, though the mean temperature rise no higher than 54·4°. From this it is clear that in regarding the influence of temperature on bringing plants to maturity, it is not mean temperature merely, but the way in which the vital element is distributed through the day and night, particularly at the critical periods of the plants' growth, which must be considered. A high mean temperature, with little variation, implies a comparatively low day temperature; and, on the other hand, a moderately low mean temperature, with a large daily range, implies a high day temperature; so that a climate with a comparatively low mean temperature may yet afford the warmth required in carrying on the higher functions of the plant which another climate of a higher mean temperature could not supply.

Now, that which in the highest degree determines the mode in which temperature is partitioned throughout the twenty-four hours of the day is the amount of cloud and the degree of moisture in the atmosphere; for a knowledge of which we must look to the rainfall through the months of the year as furnishing the best available key.

The rainfall affects plants directly through the nourishment it conveys to them, and indirectly through the state of the sky which its amount or absence implies. Indeed, so great is the influence of rainfall on vegetation that we cannot be far wrong in regarding it as co-ordinate with that of temperature. Whatever the law may be which expresses the atmospheric conditions that determine the limits of the growth of species, it must include in its functions both the heat and moisture of the air.

Decandolle deduced the law for the distribution of species over a region whose climates are marked off from each other rather by variations of temperature than of moisture. He then endeavoured to extend it so as to account for the distribution of the floræ of other regions, the climates of which may be characterised either as moist at all seasons or subject to marked variations of moisture at stated seasons. Perhaps not the least valuable of the results arrived at by him is the negative one stated in these words:—"On the borders of the Mediterranean Sea, the limits appeared so often determined by the humidity, or by causes still unknown, that the operations of temperature always escaped my calculations."

It may be predicted that when the limits of species have been drawn with some exactness for Central and Northern Europe, the regions from which Decandolle took his examples, they will be found to coincide with no mere temperature lines, however calculated and determined, inasmuch as there are much greater differences in the climates of this region than are generally supposed, as regards the rainfall, particularly in the manner of its distribution over the year.*

The practical result of these views seems to be that the same summer temperature (I mean the average temperature of each twenty-four hours) may be arrived at in two ways—

* 'Transactions and Proceedings of the Botanical Society of Edinburgh,' vol. vol. xi. Part II., 1873, pp. 262–264.

(1). By cool days and warm nights; or (2) by hot days and cold nights. Hot days are necessary for the growth of good corn crops, and if the days are hot and sunshiny, cold nights are of less importance. There is no doubt that the moisture and clouds in the atmosphere of Ireland cause cool days, with little sunshine; and though the nights are mild, that does not for the purpose of corn-growing make up for the want of heat and sunshine by day.

Dr. Lloyd, the Provost of Trinity College, Dublin, who is probably the best authority we have on the subject of Irish climate, has been good enough also to suggest to me that another subsidiary action, connected with the others of temperature and moisture, that plays a sensible part in the phenomena, is the frequent *lowering of temperature* which occurs in July in connection with the arrival of the mass of condensed vapour from the Atlantic, and which, unhappily for the cereals, occurs at the St. Swithin period, just at the time when it is most injurious to them, although advantageous to green crops. This shows itself very decidedly in the annual curves of temperature as well as of rainfall.

Mr. Whitley, in the article in the Journal above mentioned, gives the average summer temperature of Cork at 65°, being, as he adds, the highest in the British Islands. There can be no doubt that this is founded on erroneous observations. There is no such average summer temperature as 65° in Ireland. It is probable that the average summer temperature of the South of Ireland is about 60°. But 60° is a sufficient average temperature for growing wheat well. It is much more than a sufficient temperature for growing oats, which are believed only to require from 54° to 57°. Yet good crops of wheat can seldom be grown in Ireland, especially in the South, and even oats, though so much hardier, do not grow so well as in England and Scotland, especially on land that is highly farmed. My experience is that it is increasingly hard to get a proportionately good crop on high-farmed land than on land in worse condition. This is the difficulty. The temperature is high enough, according to received views, to grow wheat or oats well. But they do not grow well. Mr. Buchan's explanation is probably the true one.

There is no series of accurate observations for any long number of years extant. I have been favoured by Mr. R. H. Scott, Director of the Meteorological Department, London, with the following Table, and those in the Appendix, which are all that his Office has, and which are probably, therefore, the best and fullest attainable:—

TABLE I.—MEAN MONTHLY BAROMETRICAL PRESSURE and TEMPERATURE at VALENCIA and CORK.

MONTHS.	VALENCIA.		CORK.	
	Pressure. Mean of 5 Years.	Temperature. Mean of 5 Years.	Pressure. Mean of 11 Years.	Temperature. Mean of 13 Years.
	8 A.M. Obser. only. 1866–1870.	8 A.M. Obser. only.	1857–1867.	1857–1869.
January	29·754	43·0	29·813	41·8
February	·895	44·1	·934	43·1
March	·874	45·4	·823	44·8
April	·922	49·2	·894	49·6
May	29·861	52·9	·932	53·5
June	30·105	56·7	·998	59·2
July	30·016	60·0	·959	62·1
August	29·964	58·9	·929	60·5
September	·835	56·4	·909	57·0
October..	29·920	52·9	·833	51·0
November	30·015	46·8	·881	44·5
December	29·814	46·3	29·933	43·2
Mean for the year ..	29·915	51·1	29·903	50·9

NOTE.—The barometric values for Valencia are obtained from values kept in the Meteorological Office. All the other averages are computed by Mr. Buchan and published by him.

An interesting illustration has been mentioned to me by Mr. Scott from the climate of the Scilly Islands, which may be taken as an exaggeration of the climate of Ireland. He says :—

In Scilly, the mean monthly temperature ranges only from 45° to 63°, being a less variation than at any other place in these islands. The north of Donegal and Shetland most nearly approach it. The result of this very equable *spring* temperature is that vegetation is always going on, and no crop or fruit will ripen thoroughly. A few bad apples are the only fruit besides gooseberries. The plants that flourish there are sub-tropical, such as aloes, yuccas, mesembryanthemums, and, of course, large geraniums and fuchsias. The produce of the islands is to a great extent vegetables for the London market, especially new potatoes.

The climate is an exaggeration of your southern climate, such as Cape Clear; the mean temperature for the year being 1° higher. The reason of the very exceptional climate of Scilly is due in some measure to the set of the currents at the mouth of the English Channel.

I think the suitableness of the Irish climate for growing potatoes was one cause that led to the great extent of potato cultivation there before the famine, which has hitherto been ascribed mainly to social and political causes. Till the blight, potatoes flourished in Ireland better than elsewhere, and therefore were more grown.

In the South of Ireland corn ripens, but with difficulty, so that a good or bad crop of corn is more dependent on the character of the season than elsewhere, and the crop is more often inferior. Over thirty years ago, before the Famine, when I began to farm in Ireland, the universal rotation in the county of Cork, except near the mountains, was potatoes on lea manured (and such lea as it was!—land left to rest, without grass seeds even, and one mass of weeds; and then the manuring!—earth drawn from the field, with a little calcareous sand and the refuse of the dwelling house mixed), followed by wheat. Oats only came in as a scourging crop when the land would no longer grow wheat. The wheat was a poor crop, five or six barrels of twenty stones, about equal to twenty-four bushels, being considered good. Half that produce was much more common. But as Corn-law prices then ruled, farmers were content, except in bad years, which in that climate were frequent.

After I had been farming pretty well for some years, with only a moderate increase of crop, I remember thinking the cause must be in the previously exhausted condition of the soil, and that I might get over it, and grow good wheat by a rotation of (1) swedes, (2) rape, (3) wheat. The swedes and rape were well manured with bones, besides other manure, and half the swedes and all the rape were eaten with sheep. The wheat looked all that could be desired during the spring and summer till harvest, but it was no sooner in shock than it was enough to lift a sheaf to have a painful proof of the crop's lightness. In fact, it was worse than the crop of the small farmer in the next field, that had not been a quarter so well done by. There was sunlight enough to ripen his thin, short-strawed crop tolerably. But the ears of my handsome crop were not half filled, and much of the corn in them was only fit for chicken's food. The same result several years in succession at last taught its lesson.

I gave up trying to grow any corn except oats. The common farmers, too, have gradually ceased to grow wheat, except a small piece for their own consumption (as it is one of the curiosities of our stage of development that every farmer thinks it needful to grow the food of himself and his family on his own farm; so, as potatoes will no longer grow well, he grows some wheat wherever he can for home consumption). They, too, have taken to oats as the chief crop. Wheat being usually lower in price than it was in Corn-law times, and oats much higher, no doubt tends to the same end. There is a general opinion, too, that the local climate has altered. The oats even are not the better sorts of oats. Black Tartary oats, the coarsest sort known, succeed best by far. But even with oats, and thoroughly good farming, the produce in corn is not on the average of years what it should be; nothing like what such farming would produce in England or Scotland. The upland soil in my district is a useful turnip loam, rather thin from the rock being near the surface, but growing great crops of swedes. (Manure as highly as we please, we cannot grow half a Norfolk crop of mangolds, for the same reason, I think, that we cannot grow good corn crops.) It steadily improves with good farming in the yield of grass, and in the quantity of stock it will feed, and not at all slowly. The bottom land is generally more or less peaty, with clay below, and when drained is very good for grass. For years I have used bought manures and cake largely; last year to the value of 20*s.* per acre over the whole farm of seven hundred acres. Yet the corn hardly increases; fifty bushels of oats per acre is still as much as we can grow in a good year, even after sheep folded on swedes, with hay and cake. I am not able to give measured quantities of any value, for the farm is managed in subordination to the needs of the estate, with sometimes a slice of good land let away in order to improve a tenant's farm, sometimes a slice of reclaimed land added to it, sometimes of land given up by a bad tenant, and worn out to a degree of exhaustion that will not grow either weeds or couch (it is something to have come to look on a good crop of couch as a hopeful sign of land), and which swallows up all the manure of a year or two as a starved beast swallows good feeding without showing it. Rotation and exact quantities at successive intervals thus are made almost impossible; but my conviction is strong, from close observation, that the difficulty of growing larger crops of oats is due to the climate, which, though in ordinary years it will ripen a moderate crop, has too much moisture and too little sunshine to ripen a really heavy crop, except in chance seasons.

On the other hand, the very same climate that is so unfavourable for corn is extraordinarily favourable for grass, which continues to grow often through most part of the winter.

And this is the true explanation of the inclination to grass-farming that is almost universal in Ireland, not only among large farmers and landowners farming on their own account, but equally among middling and small farmers. The small farmer formerly tilled more of his farm in proportion, because it took much of his land to provide the food for his family, but even before the famine the constant argument used by small farmers seeking more land was, "If I get more land I can leave more out in grass." When a farmer failed, it was always said, "He tilled too much of his land." There was never any doubt but that the land paid best in grass, when the farmer could afford to buy stock. The climate was and is the ruling principle, as Mr. Whitley said. Even when the grass farming is bad, as it often is, it still pays better than the equally bad tillage farming that the same farmer would practise on the same farm. The views in favour of breaking up inferior grass so often urged in drier climates have very little place in our wet climate. There is very little land so bad that if it is once in good condition will not grow grass well in this climate. When the land needs breaking up it is almost always only as the best means of adding condition in order again to put it in grass.

Of course what I have said in no way affects the correctness of Mr. Pringle's complaints of bad grass-farming. No doubt, too, there is some land that cannot profitably be kept in grass beyond a few years. I believe, also, there is a tract of country in the East and North-east of Ireland, from Wexford to Down inclusive, where the climate is more favourable to tillage than elsewhere. When land is foul with weeds, and much worn out, cultivation with heavy manuring of green crops, is the most economical, if not the only way of getting it into condition; and without some roots and straw for winter it is not easy on middling land to manage a heavy stock to the best advantage; but I think the problem of profitable farming in these times in Ireland is (or at least is fast becoming) with how little cultivation a farm in grass can be successfully managed. There is a great change since the time when Mr. Algernon Clarke, whom Mr. Pringle quotes as his authority, wrote of Irish farming. The price of stock, and of most grass products, has immensely increased. The cost of labour has greatly increased too; not only are wages much higher, which is not to be complained of, but labourers in Ireland usually give less and worse labour for their hire. It was bad enough before with low wages, it is worse now with much higher wages, whatever it may ultimately come to. Emigration, too, is steadily lessening the supply of labour year by year. When I began, thirty years ago, if I gave out overnight that I wanted fifty men next morning for a job of work, 100 would be on the ground begging for employment. Several years ago, being pretty forward with draining and such improvements, I bethought me that it would be well to devote money to the improvement of labourers' houses over the estate. I had already built good houses for most of the men in my own regular employment. When I came practically to consider the subject I found that everything was in such a transition state that it was wiser to wait a while, and see what houses would be really wanted and where. It was well I did so, for now there are a number of labourers' houses on all parts of the estate standing empty, some of them fairly good slated houses, much superior to the common cabins of the country; more are yearly being left empty.

Extra jobs of draining, &c., can no longer be done in most years at a reasonable cost, or a fair increase on former prices.

Men are not to be had, except a few at slack times of year, and they will not do wet, unpleasant work except for very high pay, and in their own lazy way. It is often said that one advantage of more and better cultivation would be additional employment for labourers. I have always thought this a fallacy. There is more profitable work in draining, &c., wanting to be done in Ireland, exclusive of the reclamation of real waste land, than all the labourers could do in two generations, even if they worked well. There is no good reason, therefore, for the sake of the labourers, for departing from the sound principle of political Economy, that such mode of farming should be followed as will leave the largest net profit (true), whether it be grass or tillage farming. In truth, even such lightish land as I have described, when it is laid down in grass in good condition, produces excellently and for many years. The number of years that it will produce well in grass without showing signs of going back, wholly depends on the condition it is in when laid down, and on the treatment of the grass. In the neighbourhood of towns, where manure can be bought, top-dressing grass is a very favourite course, and is thought to answer especially well. Except in such places manuring grass is little understood or practised. How far artificial manures, as recommended by Mr. Thompson, of Kirby Hall,* will effect a permanant improvement in grass on such a soil as ours, which is not strong land, may perhaps be doubtful; but it is certain that any phosphates of which the soil is deprived by milk or grazing can be thus restored at small cost; and it is also certain that there are many intelligent men in Ireland, ready to try Mr. Thompson's prescription, and all other suggestions for keeping up the condition of grass land.

The conclusion I wish to draw from the facts and considerations I have stated is, that Ireland, notably the South and West, is from its climate a land of grass, and that for farming profitably in Ireland grass should be the first object, and tillage only so far as it helps the grass. I believe this is what all our best farmers are, consciously or unconsciously, working to. Mr. Pringle's strictures on the fault of much of our Irish grass farming are generally quite true, and the remedy he proposes is in a measure good, but only in a measure—not as an end, but as a means to better grass. In truth our grass privileges (as an American might call them), are very great. Farmers, who know their business, are doing excellently. It is sometimes said that landowners farming their own land in Ireland lose by it. Never was there a greater delusion. The profit on grass farming makes it all easy, whatever

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* *Vide* 'Journal Royal Agricultural Society,' 2nd series, vol. viii., Part I., No. xv., p. 174.

scale a landlord farms on; much easier than in a country fit for tillage alone. Numbers of us are making more than double the rent we used to get for the land, when let to tenants, and three times the present valuation of the land.

When land is well laid down, the first year's grass is very good. The second year is worse, because the artificial grasses are dying out and the natural grasses have not had time to take their place. The third year the natural grasses are established, and a close and excellent sward is the result, equal to good old grass in the West of England, and such as in Norfolk could not be got in thirty years, hardly in twice thirty. I have often said that such land as I have to deal with, in the Norfolk climate would not be worth half what it is in the Irish climate. Again, consider the immense rise in the price of grass products in Ireland. Twenty years ago, butter sold for 5*d.* to 6*d.* per lb. Good beef was often at 3*d.* and pork at 2*d.* per lb. 2*l.* to 3*l.* was not thought a bad price for a yearling heifer. I have bought good fair stock lambs in July for 5*s.* each. Now prices are some twice, some four times, some six times these rates, all, be it observed, for grass products. This rise of price has not yet produced its effects on our farming, and on the value of land. Some of it is still recent, at least in part—as the value of young stock—and the argument is still used and felt, "Perhaps these high prices will not hold." But as soon as the prices of stock are felt to be permanent—as the increasing demand for meat from increasing wages in England shows it is likely they will be permanent—that cause alone will be sufficient to turn the balance in favour of grass farming, wherever grass will grow fairly. I can say that in the arrangements for my own farm these considerations weigh more day by day. Corn is not higher in price, the wages to be spent in growing it are higher; but grass products, that cost little or no more wages, are many times higher in price. Can there be a doubt, from this cause alone, what the intelligent farmer will do in a climate specially suited to grass?

Grass farming in every form, and with every sort of help from bought manures or bought food for stock, cake, &c., is the true future before us.

Water meadows, the especial advantage of which, in the mild climate of Ireland, was pointed out by Mr. Philip Pusey (in the Journal, vol. xi. p. 62) more then twenty years ago, are a most valuable resource to Irish grass farmers. Mowing upland grass on second-rate land for hay is very exhausting to the soil, and we do it as little as possible. We cut hay mostly from bottom lands. But water meadows in this climate are very productive, and we grow unusual crops of hay on them, yet systematic watering is not nearly as common as it might be. Small farmers are constantly squabbling amongst themselves for the use of any rill of water near their farms. When they have got it, they often let it run the whole winter over one spot, which is thus made into a morass, especially as the cattle are seldom kept out of the field. The opportunities of making regular water meadows are very frequent, and will be made use of more and more. I have found a dressing of five or ten cwt. of bones on water meadows greatly to thicken the grass and improve the quality of the hay. They are applied as soon as the hay is off, so as to be well trodden in by the stock eating the after-grass, and avoid risk of the water washing them away when the meadow is flooded in autumn. I believe they pay well every few years, as often as the hay shows any signs of becoming inferior. My theory, I know not how correct, is that the water must contain the other food of grass in larger proportion than phosphates. The bones thus make up all that is wanted.

The course on my own farm, which has been arrived at simply from experience and the pressure of facts, will, I think, show what we are coming to. For nearly twenty years the course, instead of a regular rotation, has been to choose fifty or sixty acres of the worst grass on the farm each year for ploughing. Most of this is sown with lea oats; but if the land is very poor, no oats are taken, and then it is ploughed with two ploughs following each other, one skimming the grass as lightly as possible, the other turning a good furrow of earth over it. It is then broken for turnips the next spring. But there is more trouble in getting such land prepared for turnips than after lea oats, and the plan can only be followed to a limited extent.

The ewes are folded on the grass meant for lea oats, before it is ploughed. But still the oats are usually very bad. The older the grass, the worse are the oats. It is plain the sod does not rot in time to help the oats. In some districts they grow two crops of oats in succession, on breaking up the land; the first is bad, the second good enough, because the sod by that time is rotten. But this plan is exhausting, and leaves the land very foul. With fifty or sixty acres of turnips we have been in the habit of fattening 200 sheep and over 30 beasts, besides keeping 200 ewes and 200 hoggets of the previous spring, 60 cows, and young stock, rising yearlings and two-year olds, about 35 to 40 head of each age—enough to stock the farm in the following summer with little buying.

We have the last two years reduced the number of acres broken each year to forty instead of fifty, and still fatten and keep the same stock as before, with the help of more cake. This of course lessens the work of men and horses; and if, as is said, a ton of cake may be reckoned as roughly equal to an acre of turnips (which I do not think it is, of such crops of turnips as we grow), there is no reason that such a course should not answer and keep up the condition of the grass. In two or three years I expect the extent ploughed may be reduced to thirty acres each year, and with still more cake the same winter stock be kept and fattened. Just now I have a tract of cut-out bog that has been drained &c. coming in. This for its own sake needs cultivation and turnip cropping, and so delays the decrease of tillage. Oats with grass seeds follow the turnips, unless the land is poor, when it is laid down with rape and grass seeds, no corn crop being taken. Experience can alone show how far we can decrease cultivation, and keep up the condition of the grass land. It can clearly be done to the extent of one-half, i.e. twenty-five acres instead of fifty, being ploughed each year. The net profit on the farm is more than double the rent the tenants paid for it when they failed, after charging to each year all the cake and manure bought, bailiff's salary, and every expense. The changed appearance of the land is a pleasure to one's eyes. The stock are more than double the number, and individually double the weight of those the tenants kept.

It may seem strange to say it, but religion and politics have been brought in Ireland even into the question of farming, and whether grass or tillage are best for the country is sought to be decided by what is most to the advantage of the Roman Catholic or Protestant interests. The power of the Roman Catholic clergy and their party depends on the number of Roman Catholics; and tillage, as giving more employment than grass, has been favoured accordingly. Even the growth of flax has been urged on the same grounds. I have already shown the weakness of such reasoning, because there is plenty of work for every one for long years in draining and other improvements, far more profitable to all concerned than it can be to try to force one kind of farming instead of another that for any reason is more profitable. But there is no doubt it has been thought the increased employment from tillage would check the emigration.

My own opinion is clear that the decrease of labourers is going on so fast that by the end of the next seven or ten years there will be no choice in the matter, and it is very fortunate for us that the increased price of grass products gives us so profitable a means of escape from what would be otherwise a most serious difficulty. Those who have treated their land best will have least trouble.

On one point alone Mr. Pringle, I think, is quite wrong—when he argues against grass farming because small farmers, holding 7 millions of acres, keep on them stock to the value of $17\frac{1}{2}$ millions of money; whilst large farmers, holding $8\frac{3}{4}$ millions of acres, keep on them stock valued only at 18 millions of money. But the cattle on both sizes of farm are valued at the same rate, 6*l.* 10*s.* per head. It is evident that the cattle of the small farmer much more nearly approach this value than the cattle of the large farmer. Large farmers, as a rule, have much larger and more improved cattle of all ages than small farmers; and nearly all the fatting and fat cattle. Mr. Thompson's estimate of the weight of cattle killed in England is 600 lbs. per head on an average, which at present prices would make their value a good deal over 20*l.* each. The cattle of large farmers in Ireland probably do not weigh much less than the average of all English cattle killed, and after all due allowance for the value above 6*l.* 10*s.* of the cattle of small farmers, there must be a large excess in the value per head of the cattle of large farmers. If this excess is only fifty per cent., and it is probably much more, it will quite alter the inference Mr. Pringle draws. Considering how few turnips, &c., Irish small farmers grow, and how much they overstock their grass, and that they use no cake or bought food, it would be strange indeed if they thus grew more pounds of meat than are grown on better managed large grass farms.

The last three years have been excellent seasons for grass in Ireland. With the same stock every farmer has had plenty of grass; even those usually overstocked have had enough, and their stock has profited accordingly. Many have thus been taught the lesson of the profit of feeding stock better; the price a well-fed animal of any age has brought in the market has been so out of proportion to the price of an ill-fed one that the most backward has had the point driven into his head, and efforts at better feeding for the sake of the better profit have been numerous. I think the young cattle sold in the next few years will show the effect of this better feeding.

Such a number of calves as have been reared this year in Ireland was never seen since the world began. It is caused by the great price of young stock in the past year. The country positively swarms with calves. Hitherto small farmers have usually reared only heifer calves, and the bulls have gone to the butcher at once. This year bulls and heifers have been alike reared. This, too, if the demand continues, will in a few years help greatly to improve the quality of Irish stock. When the bull calves were sold for a trifle to the butcher at once, and many of the heifers kept as cows for himself, the backward farmer felt little the gain of putting a good bull to his cows. Where now he has so many to sell, the difference in the price of a well-bred calf or yearling on such a number will soon work more care in the choice of a bull. But most of the calves must be sold before the winter, since it is certain farmers have not food for half of them.

The same causes that have given us plenty of grass have made the potato crop a great failure. There has not been so much blight since the famine as last year and this, and the crop has been very bad. I think fewer potatoes will be grown in future, which again will lead to less cultivation and more and better grass.

In spite of all the miseries of the famine, farmers and labourers alike have since, as far as they could, gone back to the old conacre potato system. This is the explanation why for years the statistical returns have shown a regular increase in the average of potatoes; only as potatoes did not grow well enough to last the whole year the system could not fully re-establish itself as of old. Some modification to supply food in spring and summer, when there were no potatoes, was unavoidable. A few sacks of Indian meal, bought on credit, was the means used.

The terms for farmers' labourers in this district have been 3*s.* per week and the man's food at the farmhouse; the cabin, charged 6*d.* per week, and the conacre another 6*d.* per week, being stopped by the farmer out of the 3*s.* On the balance, with such potatoes as grew, wife and children existed. Of course there were some minor privileges—pig, cocks and hens, &c.

The strangest thing is that many labourers preferred such terms from small farmers to 8*s.* or 9*s.* a week, with free house, potato-land, &c., from others. I believe the secret is, that there was real work in the one case, and no real work, but half-idle dawdling in the other. This year the potatoes have failed again in earnest, but the people are now so few the effect will not be the same as at the famine. The 3*s.* per week, however, has broken down, as the labourers have no potatoes. Labourers can now be had in plenty for any job paying fair wages, and next spring will show a larger emigration to America than for years before.

It may seem presumptuous in one mainly connected with Irish farming even to offer a hint to English farmers, but I cannot help saying that I think in many parts of England the difficulties as to labour, &c., are the same as our difficulties, and the remedies that suit us will also suit them. It seems a safe general conclusion that wherever grass will grow well, more grass will lessen labour. Where permanent grass is attainable with difficulty, the Scotch five-course rotation instead of the Norfolk four-course, i.e. two years' grass instead of one, must save near one-fifth of the labour on a farm.

More grass, with higher manuring and more cake, seems to me the remedy, wherever possible, for dear labour, at a time of great demand for all grass products.

It is a very old opinion that the successful farmer is he who, with skill and knowledge of general principles, most clearly recognises the particular facts and circumstances under which his farm is placed, and applies his skill and knowledge to them accordingly. That is all I contend for under the very exceptional climate of Ireland, at a time when labour is dear, and when the value of grass products is such as has never been known or heard of, and seems likely so to continue, certainly in a measure, and possibly to a still larger degree.

It is an old saying in the Co. Meath that the labour needed on their grazing lands is, "A man and a dog to 1000 acres of land." Of course there is not much land so good as the Meath grazing lands and that can be managed with so little labour; but the principle involved in this queer saying is decisive wherever fairly good grass can be anyhow grown.

No doubt many cases can be given where cultivation to a considerable extent has been profitably carried on in Ireland, but if the circumstances and rotation of these farms are looked into, it will be found that not more than a tenth or a twelfth of their acreage is annually in green crop. This means that a good deal more than half the farm is in grass over one year old, and that the system is something quite different from that of an arable farm in Norfolk or the Lothians. It will also, I think, be found that such farms have been in bad condition, and their occupiers have been getting them into heart.

I am far from saying that during this process and under this system their farms have not paid well; my own farm has for many years been a proof to the contrary. But the fact is, that once in condition grass in the Irish climate will pay best with as little cultivation as may be, and that there is plenty of more profitable work for the displaced labour in draining, &c. Sound political economy teaches that the most profitable application of labour, whoever may gain by it, whether landlord, farmer, or workman, is the greatest gain to the community; and that all artificial attempts to force labour in a particular direction for the sake of secondary (even) good objects are a mistake, and sure to end in disappointment. I think this mistake is made by some authorities on farming in Ireland; and as political economy is little else but the correct statement of facts that are sure to produce the same results, whether correctly or incorrectly stated, only with serious loss in the meantime to those who are misled, good may be done by putting forward the above views.

APPENDIX.

TABLE II.—MONTHLY and ANNUAL RAINFALL at VALENCIA and ROCHE'S POINT.

VALENCIA.

Months.	1866.	1867.	1868.	1869.	1870.	Mean.	
						Rainfall in Inches.	Equivalent per-centage.
January	7·90	5·59	8·49	8·54	6·16	7·34	13·7
February	4·15	4·73	4·74	4·30	4·60	4·51	8·4
March	5·65	3·61	5·75	3·28	1·94	4·05	7·5
April..	5·23	4·19	3·39	4·49	3·61	4·18	7·8
May	2·40	3·29	3·48	2·58	4·50	3·25	6·0
June	2·80	1·13	1·66	0·91	0·61	1·42	2·6
July	1·86	3·58	2·74	5·22	2·05	3·09	5·8
August	5·49	5·04	2·64	2·12	2·62	3·58	6·7
September ..	5·56	5·24	3·15	8·47	4·25	5·33	9·9
October	3·54	8·82	6·35	2·17	10·03	6·18	11·5
November.. ..	3·98	2·01	7·15	4·81	4·97	4·58	8·5
December.. ..	5·92	4·51	9·70	8·56	2·59	6·26	11·6
Totals ..	54·48	51·74	59·24	55·45	47·93	53·77	100·0

ROCHE'S POINT.

Months.	1866.	1867.	1868.	1869.	1870.	Rainfall in Inches.	Equivalent per-centage.
January	..	7·10	7·17	9·92	4·34	7·14*	15·2
February	..	..	4·17	4·21	3·25	3·87	8·3
March	..	..	7·01	3·05	2·86	4·31	9·2
April..	..	..	4·39	2·07	1·41	2·62	5·6
May	..	..	3·77	5·94	5·52	5·08	10·8
June	..	0·75	1·90	0·32	1·04	1·09	2·3
July	..	5·95	1·11	2·16	1·23	1·50	3·2
August	..	7·00	3·80	1·07	1·84	2·24	4·8
September ..	..	4·00	7·81	5·30	3·01	5·37	11·5
October	..	6·53	4·39	0·67	5·61	3·56	7·6
November.. ..	..	1·65	4·50	2·33	4·06	3·63	7·7
December.. ..	..	1·77	10·35	5·47	3·64	6·49	13·8
Totals ..	..	..	60·37	42·51	37·81	46·90	100·0

* The mean at *Roche's Point* is for 3 years only—1868–1870.

Table III.—Five-day Means of the Dry and Wet Thermometers and Barometer, from the continuous Records at Valencia, for the Year 1869.

Thermometer.						Barometer.			
Five-day Periods.	Dry Bulb.	Wet Bulb.	Five-day Periods.	Dry Bulb.	Wet Bulb.	Five-day Periods.	Barometer.	Five-day Periods.	Barometer.
Jan. 1– 5	46·3	43·0	July 30– 4	62·8	58·8	Jan. 1– 5	29·606	July 30– 4	30·080
,, 6–10	49·2	47·8	,, 5– 9	60·8	58·1	,, 6–10	30·123	,, 5– 9	29·923
,, 11–15	49·3	47·2	,, 10–14	59·6	56·4	,, 11–15	29·659	,, 10–14	30·309
,, 16–20	49·5	47·8	,, 15–19	64·7	61·3	,, 16–20	30·078	,, 15–19	30·128
,, 21–25	43·9	41·9	,, 20–24	62·3	59·6	,, 21–25	29·980	,, 20–24	29·911
,, 26–30	48·1	45·1	,, 25–29	59·2	55·8	,, 26–30	28·983	,, 25–29	29·810
Feb. 31– 4	49·6	47·7	Aug. 30– 3	59·2	56·5	Feb. 31– 4	29·465	Aug. 30– 3	29·868
,, 5– 9	51·3	49·1	,, 4– 8	59·4	57·5	,, 5– 9	29·626	,, 4– 8	30·165
,, 10–14	48·1	45·3	,, 9–13	58·1	54·9	,, 10–14	30·146	,, 9–13	30·086
,, 15–19	47·5	44·7	,, 14–18	59·3	56·2	,, 15–19	29·756	,, 14–18	30·383
,, 20–24	47·4	44·6	,, 19–23	61·1	57·5	,, 20–24	30·082	,, 19–23	30·296
			,, 24–28	65·6	61·1			,, 24–28	30·154
March 25– 1	48·6	45·6				March 25– 1	30·014		
,, 2– 6	47·7	45·3	Sept. 29– 2	55·0	50·4	,, 2– 6	30·177	Sept. 29– 2	30·354
,, 7–11	42·1	39·3	,, 3– 7	60·1	57·2	,, 7–11	29·811	,, 3– 7	29·638
,, 12–16	41·7	39·2	,, 8–12	56·8	53·2	,, 12–16	29·555	,, 8–12	29·342
,, 17–21	46·1	42·4	,, 13–17	58·0	55·3	,, 17–21	30·013	,, 13–17	29·531
,, 22–26	45·3	42·0	,, 18–22	55·7	52·0	,, 22–36	30·270	,, 18–22	29·749
,, 27–31	43·7	39·6	,, 23–27	57·2	54·5	,, 27–31	30·052	,, 23–27	29·865

April	1– 5	46·6	43·5	Oct.	28– 2	55·0	52·5	April	1– 5	29·859	Oct.	28– 2	29·470
,,	6–10	52·4	50·6	,,	3– 7	59·0	56·6	,,	6–10	29·854	,,	3– 7	29·954
,,	11–15	51·7	49·9	,,	8–12	60·5	58·4	,,	11–15	29·824	,,	8–12	30·006
,,	16–20	50·0	47·1	,,	13–17	50·9	47·5	,,	16–20	29·891	,,	13–17	29·909
,,	21–25	51·8	49·7	,,	18–22	50·4	47·4	,,	21–25	30·020	,,	18–22	30·309
,,	26–30	59·0	51·8	,,	23–27	50·9	47·5	,,	26–30	30·112	,,	23–27	30·307
May	1– 5	53·4	51·4	Nov.	28– 1	52·2	50·3	May	1– 5	29·707	Nov.	28– 1	30·409
,,	6–10	48·8	45·5	,,	2– 6	52·5	50·0	,,	6–10	29·442	,,	2– 6	29 947
,,	11–15	51·1	46·3	,,	7–11	47·5	45·0	,,	11–15	29·981	,,	7–11	30·112
,,	16–20	50·6	47·2	,,	12–16	53·5	51·2	,,	16–20	29·630	,,	12–16	29·951
,,	21–25	53·2	50·2	,,	17–21	51·5	48·8	,,	21–25	29·803	,,	17–21	30·224
,,	26–30	50·6	46·6	,,	22–26	46·6	44·4	,,	26–30	30·065	,,	22–26	29·733
June	31– 4	55·1	52·8	Dec.	27– 1	47·2	44·7	June	31– 4	30·077	Dec.	27– 1	29·927
,,	5– 9	58·5	55·4	,,	2– 6	40·4	38·1	,,	5– 9	30·190	,,	2– 6	30·224
,,	10–14	53·8	49·2	,,	7–11	46·2	44·1	,,	10–14	29·844	,,	7–11	29·689
,,	15–19	54·2	51·3	,,	12–16	47·6	43·7	,,	15–19	30·225	,,	12–16	29·370
,,	20–24	56·4	53·4	,,	17–21	45·7	43·2	,,	20–24	30·249	,,	17–21	29·487
,,	25–29	61·1	57·4	,,	22–26	38·6	36·6	,,	25–29	30·235	,,	22–26	30·103
				,,	27–31	44·1	42·8				,,	27–31	29·457

TABLE IV.—FIVE-DAY MEANS of the DRY and WET THERMOMETERS and BAROMETER, from the continuous RECORDS at VALENCIA OBSERVATORY, for the YEAR 1871.

Five-day Periods.		Thermometer.		Barometer.
		Dry.	Wet.	
Jan.	1– 5	46·4	44·2	29·924
,,	6–10	45·1	42·6	29·757
,,	11–15	44·2	42·3	29·607
,,	16–20	41·8	39·5	29·188
,,	21–25	38·3	35·7	29·975
,,	26–30	43·5	41·4	29·972
,,	31– 4	45·2	43·4	29·491
Feb.	5– 9	49·1	47·1	29·923
,,	10–14	47·5	45·7	29·770
,,	15–19	49·4	47·9	29·906
,,	20–24	46·8	44·9	30·370
,,	25– 1	48·6	47·0	29·814
March	2– 6	49·6	47·0	29·576
,,	7–11	47·8	45·3	29·820
,,	12–16	43·1	40·1	29·834
,,	17–21	49·1	46·9	30·056
,,	22–26	50·5	46·3	29·822
,,	27–31	45·3	41·3	30·382
April	1– 5	48·5	45·7	30·003
,,	6–10	50·0	46·2	29·799
,,	11–15	52·2	50·5	29·569
,,	16–20	50·5	48·0	29·251
,,	21–25	51·4	48·4	29·809
,,	26–30	51·4	48·8	29·819
May	1– 5	51·1	47·5	30·042
,,	6–10	57·1	51·2	30·218
,,	11–15	53·5	49·0	29·968
,,	16–20	53·2	49·0	30·194
,,	21–25	55·8	51·4	29·865
,,	26–30	59·0	55·7	30·211
,,	31– 4	58·5	54·1	30·243
June	5– 9	57·4	53·7	30·203
,,	10–14	59·2	55·9	29·677
,,	15–19	57·6	54·9	29·668
,,	20–24	56·2	52·0	30·022
,,	25–29	56·9	54·1	29·878
June	30– 4	57·3	54·7	29·624
July	5– 9	58·2	55·7	29·847
,,	10–14	59·6	57·0	29·771
,,	15–19	60·1	57·4	29·992
,,	20–24	58·1	55·2	29·738
,,	25–29	56·8	53·3	29·624
Aug.	30– 3	58·6	56·3	29·835
,,	4– 8	61·1	59·0	30·102
,,	9–13	62·2	59·2	30·071
,,	14–18	60·0	57·1	29·816
,,	19–23	59·8	57·1	29·872
,,	24–28	59·8	55·5	30·115
Sept.	29– 2	59·7	57·2	29·917
,,	3– 7	57·9	54·5	29·842
,,	8–12	58·3	55·0	29·918
,,	13–17	59·3	55·2	30·201
,,	18–22	53·9	49·3	29·893
,,	23–27	50·8	47·1	29·478
Oct.	28– 2	52·1	48·3	29·528
,,	3– 7	51·1	47·9	29·713
,,	8–12	54·9	52·4	30·084
,,	13–17	56·7	54·9	29·812
,,	18–22	53·9	50·6	29·792
,,	23–27	52·9	50·4	30·078
Nov.	28– 1	51·5	48·4	29·468
,,	2– 6	48·8	45·5	29·899
,,	7–11	44·1	40·3	29·805
,,	12–16	50·1	47·6	30·031
,,	17–21	50·3	47·9	29·921
,,	22–26	44·8	42·2	30·020
Dec.	27– 1	39·4	36·0	30·159
,,	2– 6	37·5	34·8	30·293
,,	7–11	43·1	40·4	30·389
,,	12–16	49·3	46·3	30·317
,,	17–21	48·4	45·6	29·736
,,	22–26	47·0	44·3	29·703
,,	27–31	46·7	43·6	29·517

TABLE V.—FIVE-DAY MEANS of the DRY and WET THERMOMETERS and BAROMETER, from the continuous RECORDS at VALENCIA OBSERVATORY, for the YEAR 1870.

Five-day Periods.	Thermometer. Dry.	Thermometer. Wet.	Barometer.	Five-day Periods.	Thermometer. Dry.	Thermometer. Wet.	Barometer.
Jan. 1– 5	45·0	43·0	29·448	June 30– 4	57·4	54·9	30·010
,, 6–10	45·7	42·9	29·483	July 5– 9	59·1	57·2	29·913
,, 11–15	46·8	44·3	29·708	,, 10–14	59·3	57·0	29·835
,, 16–20	45·4	43·5	30·421	,, 15–19	59·7	58·0	30·065
,, 21–25	37·4	34·5	30·456	,, 20–24	65·8	62·4	30·037
,, 26–30	45·4	42·3	29·656	,, 25–29	62·4	58·9	30·185
				,, 30– 3	62·0	58·9	29·853
Feb. 31– 4	45·4	43·0	29·408				
,, 5– 9	43·7	41·4	29·464	Aug. 4– 8	61·0	58·3	29·745
,, 10–14	34·6	31·0	30·273	,, 9–13	64·4	60·6	30·236
,, 15–19	38·5	35·0	30·139	,, 14–18	62·9	57·7	30·075
,, 20–24	44·6	41·8	29·804	,, 19–23	61·4	57·3	30·091
				,, 24–28	60·5	55·9	29·974
March 25– 1	44·4	42·2	29·244	,, 29– 2	57·5	53·4	29·870
,, 2– 6	40·5	37·3	30·000				
,, 7–11	44·6	41·5	30·251	Sept. 3– 7	56·6	52·9	29·498
,, 12–16	46·5	44·5	29·688	,, 8–12	56·4	52·9	29·830
,, 17–21	50·3	48·6	30·276	,, 13–17	60·2	58·2	30·229
,, 22–26	43·0	40·6	30·049	,, 18–22	61·6	57·8	30·171
,, 27–31	49·1	47·2	30·329	,, 23–27	59·1	57·1	30·198
				,, 28– 2	57·9	54·7	30·352
April 1– 5	48·6	45·5	30·280				
,, 6–10	48·0	44·9	29·764	Oct. 3– 7	59·0	55·4	29·954
,, 11–15	49·9	48·5	30·227	,, 8–12	51·6*	—†	29·377
,, 16–20	52·3	49·2	29·953	,, 13–17	52·7	49·7	29·621
,, 21–25	50·7	48·0	30·260	,, 18–22	52·7	49·7	29·501
,, 26–30	48·7	46·0	30·191	,, 23–27	50·5	46·5	29·485
				,, 28– 1	52·7	50·6	30·049
May 1– 5	48·4	45·2	30·245				
,, 6–10	51·6	49·3	30·011	Nov. 2– 6	50·5	48·6	30·397
,, 11–15	50·4	47·8	29·389	,, 7–11	44·4	41·3	29·923
,, 16–20	54·1	52·6	29·951	,, 12–16	43·4	40·6	29·447
,, 21–25	54·0	51·4	30·288	,, 17–21	43·9	41·6	29·301
,, 26–30	55·6	52·2	29·854	,, 22–26	45·7	43·9	29·278
				,, 27–21	49·3	46·9	30·127
June 31– 4	57·0	55·1	30·055				
,, 5– 9	60·5	57·8	30·334	Dec. 2– 6	43·4	40·2	30·360
,, 10–14	56·9	54·6	30·020	,, 7–11	39·2	36·5	29·695
,, 15–19	57·4	55·1	30·011	,, 12–16	44·7	42·7	29·352
,, 20–24	57·7	54·4	30·324	,, 17–21	44·8	42·8	29·936
,, 25–29	56·4	53·3	30·243	,, 22–26	35·9	33·2	29·748
				,, 27–31	35·9	33·6	30·170

* Curve indistinct on 9th and 10th.

† Two days deficient; probable mean of 5 days, 48·6.

Table VI.—Mean Monthly Results from the continuous Records

Months.	Temperature. Mean Fahr.	Date. Day.	Date. Hour.	Maximum.	Date. Day.	Date. Hour.	Minimum.
Year 1869.	°			°			°
January	47·7	4	16	53·7	21	15	37·0
February	48·8	4	15	54·6	1	18	39·1
March	44·6	24	4	53·4	14	14	34·4
April..	51·9	27	4	69·6	3	5	37·4
May	51·4	24	4	63·4	11	16	40·1
June	56·8	30	6	74·3	13	16	45·8
July	61·4	16	3	77·9	26	17	50·7
August	59·9	27	3	82·3	31	17	47·1
September	57·2	4	2	68·4	11	17	45·6
October	54·1	9	2	73·4	19	11	42·4
November	50·1	18	1	57·4	10	19	35·7
December..	43·9	18	2	55·0	27	11	27·7
Annual	52·3	..		..	..		..
Year 1870.							
January	44·3	16	0	53·2	21	11	31·3
February	41·7	5	19	52·3	13	10	30·3
March	45·6	18	2	57·6	{22 / 4}	{16 / 17}	34·4
April..	49·7	17	4	61·5	14	18	37·8
May	52·4	25	3	65·6	1	18	40·7
June	57·7	7	1	73·5	16	13	49·0
July	60·9	24	1	79·6	1	17	51·2
August	61·6	13	1	77·6	30	15	46·2
September	58·6	22	2	71·0	10	15	45·2
October	53·6	3	4	68·3	9	15	39·0
November..	46·5	4	1	56·5	17	20	33·8
December..	40·8	13	17	52·7	29	21	27·2
Annual							
Year 1871.							
January	43·1	6	3	51·3	24	20	31·4
February	47·9	6	23	52·9	1	14	37·0
March	47·7	24	3	64·2	14	17	34·3
April..	50·7	9	3	58·7	3	16	40·0
May	55·1	29	2	72·9	9	17	42·3
June	57·5	1	3	69·4	23	16	46·3
July	58·4	16	0	66·7	9	17	50·3
August	60·5	6	4	71·2	21	14	51·0
September	55·7	16	3	70·5	23	18	39·0
October	53·5	12	2	62·2	7	19	38·7
November..	46·7	2	2	58·1	11	12	33·8
December	45·1	18	1	54·5	5	19	30·4

at Valencia Observatory, for the Years 1869, 1870, and 1871.

Pressure.								
Mean.	Date.		Maximum.	Date.		Minimum.	Mean.	
							Vapour.	Dry Air.
Inches.	Day.	Hour.	Inches.	Day.	Hour.	Inches.	Inches.	
29·709	8	11	30·329	28	7	28·386	·274	29·435
29·893	12	22	30·462	1	0	29·007	·277	29·616
29·968	23	8	30·418	16	6	29·169	·222	29·746
29·927	24	23	30·258	15	13	29·282	·305	29·622
29·755	29	10	30·317	6	15	28·961	·291	29·464
30·136	22	12	30·413	12	18	29·527	·361	29·775
30·011	13	21	30·410	25	4	29·553	·441	29·570
30·193	31	23	30·530	2	19	29·640	·411	29·782
29·647	1	9	30·529	12	14	29·064	·374	29·273
30·107	21	22	30·580	15	20	29·343	·344	29·763
29·997	19	10	30·561	22	1	29·281	·299	29·698
29·777	5	11	30·563	13	3	28·821	·230	29·547
29·927	..		..	..		..	·319	29·608
29·852	22	23	30·543	7	13	28·541	·229	29·623
29·737	11	20	30·482	27	8	28·726	·207	29·530
30·078	6	11	30·472	15	11	29·301	·250	29·828
30·112	15	12	30·499	8	14	29·063	·281	29·831
29·951	24	11&21	30·453	11	17	28·743	·321	29·630
30·179	5	22	30·573	17	6	29·828	·395	29·784
29·997	19	10	30·329	11	22	29·689	·465	29·532
30·016	30	10	30·373	4	16	29·520	·420	29·596
29·989	16	10	30·465	8	12	29·114	·400	29·589
29·684	1	0	30·416	11	19	28·795	·335	29·349
29·745	3	10	30·518	23	10	28·802	·257	29·488
29·869	2	22	30·483	13	18	28·540	·199	29·670
29·740	23	22	30·268	15	10	28·174	0·231	29·509
29·874	21	11	30·505	2	17	29·018	·289	29·585
29·919	28	23	30·562	5	21	28·922	·259	29·660
29·708	4	0	30·185	18	6	28·893	·299	29·409
30·084	20	0	30·390	23	20	29·594	·322	29·762
29·929	25	3	30·405	29	0	29·337	·371	29·558
29·782	17	11	30·194	25	18	29·450	·404	29·378
29·963	27	0	30·485	23	21	29·321	·434	29·529
29·852	13	10	30·316	26	18	28·931	·342	29·510
29·793	24	22	30·374	28	14	28·888	·335	29·358
29·955	30	23	30·402	6	16	29·532	·252	29·703
30·006	10	23	30·497	27	16	29·011	0·236	29·770

XV.—*Illustrations of Irish Farming.* By R. O. Pringle, Editor of the 'Irish Farmers' Gazette.'

In a previous paper in the Journal* I had occasion to enter into details, which may be regarded as illustrating Irish farm management under certain circumstances. Those details show, for the most part, the defective points in Irish agriculture; but the few examples I now purpose to describe, illustrate a higher class of farm management. The number of examples of this kind might easily have been increased, but a few cases, taken from different ranks of Irish agriculturists, not being proprietors, will be found quite sufficient to serve the purpose I have in view, namely, of showing that "what one man has done, another may do." The examples here given comprise the largest class of tillage farms, the medium class, and also the smallest, or cottage-farm class.

Before proceeding to describe the system of management pursued on these farms, it is necessary to state that I have been occasionally obliged to use Irish measures of land, and Irish denominations of the measure or weight of grain. These local denominations are confusing to those who are unaccustomed to them. The Irish, or plantation acre, is equal to 1 acre, 2 roods, 19 perches imperial; it is used in nearly all parts of Ireland. The imperial, or statute acre, is also used in some districts, and is the denomination adopted in all official documents. In most parts of Ulster the Cunningham, or Scotch acre, is used. The Cunningham acre contains 5760 square yards, and is, therefore, nearly midway between the statute acre and the Irish acre.

With regard to measures of corn weight there is also diversity. In the north of Ireland, and in some other parts of the country, corn is bought and sold by the imperial stone of 14 lbs.; the cwt., 112 lbs.; or the ton, of 20 cwt., according to Act of Parliament; but in the Dublin market, and the central districts generally, the "barrel" is still used, although illegal. But the confusion is rendered still worse by the fact that a "barrel" of one kind of grain may not mean a "barrel" of another. Thus, 20 stone, 280 lbs., is a barrel of wheat, rye, beans, peas, and potatoes; but 16 stone, 224 lbs., is a barrel of barley or rape seed; and 14 stone, 196 lbs., is a barrel of oats. Some years ago Government was importuned to take steps in order to render all weights and measures used in Ireland uniform, and to abolish certain illegal practices which had crept into the dealings of buyers with sellers, consisting chiefly of arbitrary deductions

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* Second Series, vol. viii., Part I., No. XV.

from actual weight, &c. After several unsuccessful attempts, a "Weights and Measures (Ireland) Amendment Act," was passed on the 7th of August, 1862, which enacted that every kind of farm produce was, after the 1st of January, 1863, to be bought and sold by the imperial standard ounce, pound, stone, quarter hundred, half hundred, hundredweight, or ton. Certain penalties were fixed to be imposed in the event of any infringement of the Act. For some time the provisions of the Act were observed, but in the course of the month of August, 1863, the Directors of the Corn Exchange in Dublin put up a notice virtually setting aside the Act, and ever since that time it has been a dead letter; so much so, in fact, that many persons seem unaware that such an Act is in existence, and that they lay themselves open to fines each time they buy, sell, or quote grain by the barrel. This circumstance has been repeatedly taken notice of in Irish agricultural journals, but the authorities have never taken any steps to enforce the Act.

Cloona Castle Farm, County Mayo.

The farm of Cloona Castle, or, to use the original Irish name, Cuil-na-gCaisol, is situated near the town of Ballinrobe, barony of Kilmaine, county of Mayo. It is placed in the centre of that part of Ireland which has the greatest rainfall, and but a short distance from the mountains of Connemara, and Loughs Corrib and Mask.

Properly speaking, there are two farms, Cloona Castle and Gallows Hill, but they adjoin each other, without any other place intervening; are worked together, as regards rotation and stock; and constitute, therefore, to all intents, but one farm. It is held by Mr. James Simson, a native of Roxburghshire, who entered upon it in October, 1855, on a lease for twenty-five years, at an annual rent of 20*s.* per imperial acre. The farm consists of 2200 acres, statute, 1800 acres being good arable land, and the rest bottom land, or cut-away bog. The soil of the district is on limestone, either rock or gravel. Cloona Castle forms part of the estates belonging to the Earl of Lucan. Previous to the famine of 1846-47, the land had been covered with a swarm of pauper tenants and cotters, amongst whom great wretchedness prevailed even before the pressure of the famine years, and the miserable condition of the people was of course rendered still worse by that great calamity. Constant burning of the surface, and over-cropping, had thoroughly exhausted the soil. The nominal rent, which was not half the present rent, was not paid, and the landlord had besides to pay annually 400*l.* to 500*l.* as poor-rates. Lord Lucan bought out some of the occupiers, who mostly emigrated, or became labourers, while not a few succumbed, as in other parts of the country, to the combined effects of hunger and pestilence. To permit people to struggle on in such a hopeless state was not a kindness to them, nor was it conducive to the general welfare of the community. As soon as Lord Lucan got the land into his own possession, he commenced operations to put it into shape, for the purpose of letting it as one farm. Farm offices of a substantial nature were built, stone fences erected, dividing the farm for the most part into fields of 30 acres, and the land was also partly drained, and brought to some extent into a regular system of cropping; the cost of Lord Lucan's improvements being over 10,000*l.*

At the time when Mr. Simson took the farm, the nearest railway station was over 30 miles distant, but the Irish Great Northern and Western Railway has since been opened, so that the distance from the nearest station, Claremorris, is about 8 miles. This has proved a great accommodation to the farm in sending live-stock and other kinds of produce to market.

Of the 1800 acres of arable land, 300 are kept in permanent grass, as pasture for sheep. The remaining 1500 acres are cultivated under a rotation. The breadth under turnips is usually about 220 acres, and of grain crops about 400 acres. The grass break of the rotation extends over two years, or even over three years if possible. Turnips are frequently grown as the first crop after lea, even old pasture, when such has been broken up, and Mr. Simpson prefers this plan to the usual mode of taking oats after lea, followed by turnips. In preparing the lea for turnips, the first thing done is to skim plough 3 inches deep in December, and following each skimming plough is another which turns a furrow 9 or 10 inches deep over the first. This buries the grassy sod, which rots in the bottom, supplying afterwards a large amount of plant-food, while the surface becomes "like an onion-bed" in spring, easily worked and easily cleaned. Mr. Simson has found that in working the land in spring for turnips, if he harrows the land immediately after cross-ploughing without an interval between the operations, he is sure to have wire-worm, but if he allows the land to lie untouched for the space of a week or ten days after cross-ploughing, before putting the harrows to work, he is free from insects, and the land also works more kindly. The turnip crop in all cases is well manured with dung and artificial manures—guano and bone manure. Sowing swedes begins about the 20th of April. They are grown in 28-inch drills (ridges), and are thinned out at 14 inches apart, yellow turnips at 12 inches, and later sown at 10 inches. The crop is partly consumed by sheep netted on the ground. When turnips follow lea, the next crop is wheat, with which grass seeds are sown. This is a short rotation, but it puts the land into great heart. In other cases the rotation is oats after lea, turnips, &c., barley or oats followed by two or three years pasture. That part of the turnip crop reserved for cattle is stored during December, in large triangular heaps covered with straw at the farmsteads. In 1871, Mr. Simson grew some sugar beet with the intention of trying its value as food for fattening cattle. The crop was very satisfactory as to weight, and the roots were evidently full of saccharine matter. They kept remarkably well into spring, and were found to answer well for fattening.

The variety of wheat grown at Cloona Castle is Grace's Champion. The average yield is 1 ton, or say 36 bushels per statute acre, the weight per bushel being usually from 62 lbs. to 64 lbs. Mr. Simson's wheat is much liked by the millers who have been in the habit of getting it, and invariably commands the highest price going at the time, the quality being very fine. Oats and barley also generally yield each about a ton per acre. Black or speckled oats succeed better than the white varieties. The oats weigh 42 lbs., and the barley 56 to 58 lbs. per bushel. The cereal produce is, therefore, somewhat under that of high-farmed land in Scotland or England, and this may be owing partly to a want of sunshine, but a hot bright sun is injurious to grain grown on limestone soils, as the crops ripen too rapidly under such circumstances. On the other hand, the turnip crop benefits by the want of bright sunshine, and more than compensates for the comparative inferiority of yield in the cereals; for the produce of an acre of turnips in Ireland, when properly cultivated, is heavier than in Great Britain, the turnip crop on Mr. Simson's farm being generally from 35 to 40 tons an acre. I may mention, in connection with this point, that Mr. Simson has won two cups in "All Ireland Competitions" for the best turnips; one being a 50*l.* cup or first prize, and the other a 40*l.* cup, representing second prize for the best 10 acres of swedes. Mr. Simson considers that to grow a heavy crop of turnips on such land as he occupies, the crop should not come oftener than once in six or seven years.

The grass seeds used by Mr. Simson are, per statute acre, 3 lbs. Alsike clover, 2 lbs. red clover, 2 lbs. yellow clover, 2 lbs. white clover, 1 lb. of cow-grass, 4 lbs. timothy, 4 lbs. cocksfoot, with sufficient quantities of perennial and Italian rye-grass.

The farm presents a complete illustration of that system of combined tillage farming with stock rearing and feeding, which it is so desirable should be extended in Ireland. The intermixture of corn, cattle, and sheep makes the yearly returns very equal, as any decrease in the value of one class of produce is usually made up by a rise on others.

The objections generally urged against this system are that labourers are not to be had when required, and that when procured their wages run so high that employment of labour in farm work becomes too expensive to admit of tillage farming being remunerative. Mr. Simson, however, finds no difficulty whatever arising from such causes. Although he is now paying his labourers of all kinds fully 75 to 80 per cent. higher wages than he did when he became tenant of the farm, yet his labour account at the end of the year is not heavier now than it was during the early years of his occupancy. The labour bill at Cloona Castle has been about 1200*l.* a year for the last 17 years, or say 2*l.* an acre on each acre under root and cereal crops. Mr. Simson keeps a number of persons in employment as extra labourers, at draining and other kinds of work, and these come in to help at a pinch. Their wages, with constant employment, when engaged in day-labour, are 1*s.* per day; when engaged in draining they are paid by measurement. The ploughmen have from 11*s.* to 14*s.* a week, according to experience, foremen ploughmen getting more; day labourers get 8*s.* to 9*s.* per week. Women constantly employed on the farm, wet and dry, get 8*d.* per day in summer, and 7*d.* in winter, and some have in addition, free houses, 1000 yards of potatoes planted for them, and liberty to cut as much turf for fuel as they please, which is carted home to them from the bog. The ploughmen are engaged by the year, but the engagement may terminate with a month's notice on either side. They seldom change, and there are men now working on the farm as ploughmen and in other capacities, who entered into Mr. Simson's employment 17 years ago.

The causes which have operated in keeping the labour bill steady as to the total amount, notwithstanding a rise of 75 or 80 per cent. in wages, have been, in the first place, the steadiness of the people, and next, the extended use of field machinery, more especially mowing and reaping machines. Of these Mr. Simson uses four of Samuelson's self-delivery reapers, one Samuelson's combined machine, and one of Wood's machines. In 1870 he harvested 400 acres of corn, having the crop safe in the stack-yard in 23 days from beginning harvest; and in 1871, although interrupted by broken weather at first, the crop of fully 400 acres was all safe in the yard within a month after commencing operations. Last year, notwithstanding the very unfavourable nature of the weather during harvest, the crops on Mr. Simson's farms were all cut and carried within 35 days from the commencement of harvest operations. All this was effected without having to call in much extra labour beyond the regular hands on the farm, a few women to lift after the machines being the only extra persons employed. There is no doubt that but for the reaping machines it would have been difficult, indeed almost impossible, to have harvested the crops so expeditiously, as formerly fully 400 persons used to be employed each harvest in reaping, &c.; but they are not to be had now, even if it were desirable that reaping should be done by manual labour.

There is one point which deserves to be noticed as facilitating harvesting, as well as other kinds of farm labour in the district in which Cloona Castle is situated. The rainfall, as ascertained by Mr. Simson's rain-gauge, averages from 36 to 38 inches in each year; * but the air possesses a strong drying power, so that it has frequently been the case that about 4 hours drought—caused by a current of warm air direct from the south-west—has been sufficient to dry sheaves of wheat so as to admit of their being carried, although previously drenched with wet. This warm current of air is a result of the Gulf stream which touches the western coast of Connaught.

Live stock forms a main feature in Mr. Simson's system of farm management. The working horses were, until lately, all of the Clydesdale breed, imported from Scotland—good, short-legged, active animals, and capable of going through much hard work. Of late years Mr. Simson has been putting his Clydesdale mares to a superior Suffolk Punch stallion, imported by Lord Lucan, for the use of his tenants, and the cross has "nicked" remarkably well in all respects. The working staff consists of 26 horses, besides 11 which are either young horses rearing, or saddle and harness horses.

The sheep-flock consists chiefly of Border Leicesters, kept up by importations of rams from Kelso. Some well selected Roscommon ewes have occasionally been added to the breeding flock, but these were put to Border Leicester rams. In this way additional size was obtained, while the cross is found superior in quality to their dams.

The flock consists of 1000 breeding ewes with their produce, and 40 to 50 rams. The small lambs are sold when weaned, and the rest carried on as will be described. Over 1000 sheep are sold annually off the farm.

The rams are put to the ewes about the 10th of October in each year. The ewes get turnips, one cart-load to the 100 being laid down for them on the grass from the 1st of January until the lambing season commences, after which the quantity of

* The rainfall from 1st January, 1872, to 1st January, 1873, was $52\frac{6}{10}$ inches, or fully 15 inches over the average.

turnips is increased; 300 tons being always stored specially for their use. Last winter, owing to the exceedingly wet and unfavourable nature of the season, as well as of the previous summer and autumn, Mr. Simson considered it necessary to improve the feeding of his breeding ewes. This he did by allowing each sheep ½ lb. of bran, mixed with 1 lb. of oats, beginning about the 15th of January, and continuing until the 10th of March, and the result was that he had only four deaths among 1000 sheep. The lambing season was also very successful, 1000 ewes having produced 1400 lambs. When the ewes, which are run thinly over the pastures during winter, begin to drop their lambs, those which are nearest yeaning are kept in a large field during the daytime, and brought into a smaller enclosure of five acres at night. This field is provided with small paddocks, into which the lambs dropped during the night are put with their dams. There is also a hut, with fire-place, &c., in the field, for the shepherd who attends to the flock throughout the night. The ewes and lambs are turned into first year's grass until the milk comes freely on the ewes, after which they are changed to older pasture, with the exception of ewes that have twins, which are not removed from the young grass. Mr. Simson finds that eating down the young grass early in this way, even so late as the beginning of May, does not prevent him having an early and good crop of hay, from such of his fields as he may afterwards shut up for mowing. If required, he topdresses, after the ewes and lambs have been removed, with guano at the rate of one cwt. per acre, which gives a large return.

The lambs are branded when turned out from the lambing-field, the tups on the left rib, and the ewe lambs on the left buttock. This simplifies matters when the tup lambs are taken up to be castrated, which is done when they are about a month old. The tails of all the lambs are cut at about the same time, leaving them a hand-breadth in length. The great advantage of feeding the ewes well before and after yeaning is, that the lambs are strong, and thrive well afterwards, so that there is none of that tendency to scour and weakness which is prevalent where ewes and lambs are poorly nourished.

The fattening and most of the other dry sheep are washed in a clear running stream, shorn about the 1st of May, and the ewes and ewe hoggs a month later. The lambs are dipped with Biggs' dip, a few days after the ewes are shorn, to keep off maggots, and all the flock is dipped in October with McDougall's dip, chiefly to destroy and prevent ticks, as no cases of scab occur, the fences being sufficient to keep strange sheep from getting in. The reason why Biggs' dip is used in the first instance is, that it is more effective than any other in preventing maggots during summer. The dipping-place is constructed in an excavation or tank lined with brickwork. The size is 8 feet long, 22 inches wide, and 3 feet deep. A sloping ladder of brickwork, set on edge, enables the sheep to pass into the dripping place, the dimensions of which are 16 feet by 9 feet; it is paved with Malbay (Co. Clare) flags, and slightly sloped in the bottom, which allows the drippings to run back into the tank, and thus prevents waste of material. This tank cost about 3*l.*

The lambs are weaned about the 12th of July, and after being branded with the stock brand, are put on second year's pasture, or even older grass, avoiding first year's grass, which appears to bring on worms in the bronchial tubes and scour. Such, at least, has been Mr. Simson's experience. He has invariably noticed that his lambs are affected with worms in the bronchial tubes when they have been weaned, and kept after being weaned, on young grass, whereas they are always free from the disease when weaned on older pasture. The pasture, however, is frequently changed, and the lambs are seldom allowed to remain in one field longer than a fortnight at a time; and I may remark that the importance of this point in the management of sheep, especially of weaned lambs, does not appear to be understood or appreciated by many Irish breeders of sheep. I have seen lambs kept for several months in one field, without ever having been shifted even for a day into another field.

In autumn, out of 500 ewe lambs, 350 are selected to be retained for keeping up the breeding-flock. This selection keeps the breeding-flock even, and preserves a strong family likeness throughout. These get turnips and hay until the 1st of March, by which time the pastures are sufficiently forward to maintain them. The draughted, or "cull" ewe lambs are sold. Part of the ewes which are four years old are sold to graziers in Leinster, &c., for the purpose of producing a "crop" of market lambs for butchers, and the rest of the draughted ewes, together with the wedder lambs and other draughted sheep, are prepared for the winter course of feeding on turnips by first netting them on cabbage. Of this crop Mr. Simson grows every year from eight to ten acres; the variety being the Drumhead. The plants are put down in April, on a good allowance of farmyard dung, and are topdressed with guano and superphosphate after they begin fairly to grow. In this way heavy crops are produced, which prove an excellent preparation for turnip-feeding. The sheep are folded by means of nets on the crop, and get hay in moveable racks. The cabbages are very nutritious, and do not scour the sheep. When on turnips, those sheep which are being pushed forward get each one pound a day of a mixture of linseed-cake and crushed oats and barley, also hay at will. If the weather proves rainy, so that the land becomes soft, the sheep are removed to a grassfield, where they get turnips, a supply of which had previously been stored to meet a contingency of this kind. Those which are not finished on turnips are carried on during summer and autumn on grass, but all are cleared off before next Christmas. The average weight of the sheep is 20 lbs. a quarter; and the average weight of fleece of ewes and hoggs 6½ lbs. The wool is sent to a firm of wool-brokers at Leith, in Scotland, and brings usually the highest price, beating the best wool grown in Berwickshire. I need scarcely say that owing to the manner in which the flock at Cloona Castle is treated the per-centage of deaths is very small.

The cattle kept by Mr. Simson are short-horn crosses, mostly purchased in the fairs held in Co. Mayo. Some of them show evident traces of their descent from the old Longhorn blood. They are large beasts, with thick, sappy hides, and fatten readily, weighing 8 and 9 cwt. of beef when 3½ to 4 years old. Mr. Simpson also keeps a well-bred short-horn bull; and a number of calves, generally about twenty, got by him, are reared annually.

I may state that Mr. Simson prefers a white bull, if he is thoroughly well bred, finding that a bull of that colour is more apt to get roan calves than a bull of a more fashionable colour.

The system which Mr. Simson pursues with regard to the bulk of the cattle kept on his farm is to buy 100 two and a half years-old bullocks in October. These are run on coarse bottom pastures until February, and then take the place of the fat stock that have gone out to market. They get, when in the houses or boxes, 3 lbs. each daily of a mixture of oats and barley bruised, and plenty of oat straw. No turnips are given to them, and they are run out during the day on the bottom lands. About the beginning of May they are turned out altogether, their pasture continuing to be the coarse bottom lands, and on these they remain until the middle of October, when they are put up to fatten in houses and boxes. They are then fed twice each day on turnips, the feeding-hours being 5.30 A.M. and 2 P.M. Between these two feeds each animal gets on the average 11 stone of turnips. At 11 A.M. they get a ration of mixed food, consisting of 1 lb. of crushed cake and 2 lbs. of crushed oats, barley, and light wheat. After a time the proportion of cake is increased to 3 lbs. per head. A little hay is given for the first six weeks or two months, as they eat greedily at first of the turnips, and the hay serves as a corrective. They get plenty of oat straw and wheat straw at all times.

The fat cattle begin to go out to market about the middle of January, and from that time until the middle of March. As they go out they are replaced by the store bullocks, 100 of which had been bought in October, as already mentioned. The calves reared on the farm are well fed from the first, and are sold out fat when 2½ years old; the liberal way in which they are reared, as well as their improved breeding being in their favour. The purchased bullocks pay 20*s.* a month from the time they are bought until they leave the farm fat; that is, altogether, a return of 15*l.* to 16*l.* each for their keep, and with this Mr. Simson is quite satisfied. He does not, however, attach so much value to cattle as farm-stock as he does to sheep, which he finds more profitable; but the cattle utilise the straw, and make a large quantity of manure.

Stall-fed cattle have sometimes insects upon them, which gather along the back and about the tail. To prevent this, the fattening cattle which are tied up are curried once every day; and in the event of any insects appearing, the parts most liable to be affected are dressed with the ordinary sheep dressing, which consists of a mixture of tobacco water, spirit of tar, and soft soap.

The accommodation for the fattening bullocks consists both of cattle-houses (byres) and boxes. There are two of the former, which accommodate fifty bullocks between them. A man attends each byre, and feeds and curries the cattle. The cattle have the turnips cut for them, which is done by means of the ordinary hand-slicer as required; this keeps the turnips fresh, and avoids loss of the natural moisture of the roots.

There are 45 double boxes, under a continued line of roofed sheds. The back wall is built close up to the wall-plate, but the front is open, and the under portion sparred. The boxes are separated by partition walls, which, with the back wall, are all built of plain masonry; and the size of each box is 18 feet by 14 feet. These double boxes are divided by moveable sparred partitions, so that each animal stands by itself, although there are two in the box. A trough for turnips is placed at the front of the box, and there is another trough at the back to hold meal and cake. The boxes are sunk 2 feet below the level of the ground, and are emptied every third month, so that the animals are only disturbed once during the period they occupy the boxes. Fresh straw is supplied as litter every day, the dung is firmly tramped down, and there is not the slightest smell from it. The plan adopted in constructing these boxes secures both warmth and abundance of fresh air, and the cattle thrive well in them.

Swine do not form a leading feature among the live-stock kept at Cloona Castle. Those which are kept, however, are Berkshires, direct from Lord Clermont's styes.

It will be observed that Mr. Simson sends to market a large proportion of the cereal crops grown on his farm, in the shape of beef, mutton, and wool. Besides home-grown food, he purchases annually about 300*l.* worth of linseed cake, while his outlay for artificial manures reaches fully 800*l.* per annum. Among the manures are 40 tons of rough bones from South America, and as large a quantity as he can procure from persons who go about the country gathering bones. The bones are broken down, and dissolved partially with sulphuric acid. The effect of bone dressings on the crops at Cloona Castle, Mr. Simson describes as something wonderful; and, therefore, while gradually going over the entire farm with bone-manure, he has dressed some parts twice, and even thrice with it.

The land in Mr. Simson's occupation, as already intimated, consists of two farms, namely, Cloona Castle and Gallows-Hill farm; but they are practically one farm. Lord Lucan had put up steadings at each farm, of a plain, but substantial character. The buildings erected by his Lordship were considered, at the time, as likely to be amply sufficient; but such has been the effect of Mr. Simson's system of management, that he has been obliged to add 1200 feet of shedding (cattle boxes, &c.), at his own expense, in order to accommodate the cattle, and this addition is barely adequate to accommodate all the stock. The additional shedding is partly thatched, partly slated, and partly covered with thin plates of iron, each row of plates overlapping that which is under it, and this Mr. Simson considers the best roof. Two 8-horse power fixed steam-engines—one at each place—drive the barn machinery, cake and corn crushers, bone mills, and timber-sawing machinery. The water obtained from wells in the district being highly charged with lime, Mr. Simson has every building spouted, and the rain water collected into tanks. The engines are supplied from these tanks, and the rain water so collected is also used for all household purposes, after being first boiled, and then filtered through charcoal. By using rain water incrustation in the inside of the boilers of the engines is prevented. Turf is the fuel used to heat the engines. The same methodical arrangement which is carried out in all departments of Mr. Simson's farm management extends to the cart and implement sheds. Each ploughman or carter has his own space allotted to him, where everything he requires is stored; the good rule of "a place for everything, and everything in its place," being a standing law at Cloona Castle. A forge and carpenter's shop are essential adjuncts, where so much requires to be done, and the smith and carpenter have constant employment.

Mr. Simson has drained a large extent of land since he became tenant of Cloona Castle, and he is still doing so, notwithstanding that his lease is drawing near its termination. The drains are 3½ to 4 feet in depth, and from 30 to 40 feet apart, but in bog the distance apart ranges from 40 to 90 feet, and 4 feet in depth. The minor drains are generally filled 15 inches deep, with broken stones; in some cases pipes have been used. Where the stream is strong the conduit is built with stones, having an opening for the passage of the water, 12 inches in height, and 9 or 10 inches wide. The draining is done by piece-work; cutting has cost 6*d.* per Irish perch of 21 feet, and the stones are broken and filled in for another 6*d.* per perch. In laying off a field for draining Mr. Simson follows a plan—devised by him a number of years ago—to find the true fall of the field, by means of which the bottom of each drain is kept on a level with the one parallel, and clears inequalities more satisfactorily than by the usual mode of adopting an ordinary furrow as the line of drain. By this plan the level is first taken about midway down and across the face of the declivity, and having got that level a furrow is drawn to mark it. The drains are then set off at right angles to this furrow, at such distances apart as may be considered desirable. In some fields more than one dead level will require to be taken. Those to whom Mr. Simson has communicated this method of laying off drains have found it very satisfactory, as it is almost impossible to do so correctly by the eye, or by taking the ordinary furrow as a guide.

On the Cloona Castle division of the farm there is a fair extent of plantations, mostly old timber, which gives a warm appearance to the place; but there are a thousand acres at Gallows Hill which an American would call a splendid clearing, for there is not a single plant upon the whole extent in the shape of a forest tree. This is certainly a great defect, more especially as that division lies high and exposed; and 100 acres at least might be planted with great advantage to the farm.

Another improvement much required on Mr. Simson's farms is cottage accommodation for labourers. It is a matter of necessity that the persons required for the labours of a farm be resident in cottages on the lands, so as to be near their work. The families of these labourers would also form a reserve from whence hands could be provided, either for every day matters or in busy seasons. When the labourers employed on a farm are, as is mostly the case in Ireland, holders themselves of small farms, they and their families cannot be depended upon at all times, as their own concerns require frequently to be looked after.

Besides the farms of Cloona Castle and Gallows Hill, Mr. Simson now holds the farm of Kilrush, on the estate of

T. S. Lindsay, Esq., of Hollymount. Mr. Simson managed this farm, which is about three miles from Cloona Castle, for several years, on behalf of the representatives of the late Mr. Laurie, but the lease has recently been renewed in favour of Mr. Simson. It consists of 480 acres of good arable land, and is managed in precisely the same way as Mr. Simson's other farms. A large steading was erected at Kilrush several years ago, but Mr. Simson has been obliged to add to it in order to accommodate his fattening stock during winter. From 60 to 70 heavy bullocks are fattened during the winter season, and the stock of sheep consists of 300 breeding ewes and their produce, which are fed off as hoggets.

In concluding this account of Mr. Simson's system of farm management, I would observe that it affords the best possible proof of the correctness of the views I put forward in my previous paper already quoted, with reference to the means best calculated to develop the food-producing capabilities of a large proportion of the soils of Ireland; and there is no room to doubt that an extension of the system would add materially to the wealth and prosperity of the country. It will be well for Ireland when all classes of farmers in the country learn to look upon their farms as the best and safest bank of deposit for their capital, whether that capital consists of cash or of their own industry.

Trynanny, County of Monaghan.

The farm of Trynanny, occupied by Mr. David Patton, is situated on the Leslie Castle estate, near the village of Glasslough, a station on the Ulster Railway. It consists of 80 Irish acres, or 129½ imperial acres. Mr. Patton is a tenant at will; but enjoys the usual Ulster custom of tenant-right. He has been in occupation of the farm, or most part of it, for 15 years, and what now constitutes the farm was held, prior to his occupation, in four different lots, the tenant-right of which he purchased at fully 9*l.* an Irish acre. The rent is 25*s.* an Irish acre, or 15*s.* 5*d.* an imperial acre; to which the interest on the money expended in purchasing the tenant right should be added, and at 5 per cent., this would make the rent 34*s.* an Irish acre, or 21*s.* an acre imperial. It may be remarked that the rents on Mr. Leslie's property in that part of Monaghan, run from 12*s.* 4*d.* to 18*s.* 6*d.* an imperial acre, which is lower than the rates current on some estates in the same neighbourhood, the rents in such cases, running up to 24*s.* 8*d.* per imperial acre. Most of the farms in the neighbourhood are held at will.

The soil of Mr. Patton's farm is chiefly a good medium loam.

The fields have been all squared, and divided by well kept ground hedges or wire fences. They are now generally from 8 to 10 imperial acres in extent, but under the old system they did not exceed 2 or 3 acres, and the great earthen banks and hedges which constituted the fences at that time, took up a large extent of ground, which is now added to the farm by the removal of the old obstructions. Until recently, Mr. Patton followed a five-shift course, that is, the usual four-years' course extended by one year in pasture; but, latterly, he has adopted a six-years' course, viz.:—(1) oats, (2) roots, (3) wheat, and partly oats, with grass-seeds; (4) hay, (5 and 6) pasture. A little variation occurs in this rotation, as he grows beans to a small extent, also both winter and summer vetches, usually after wheat, or any other part of the rotation he may consider most suitable at the time. About 13 tons of bone manure and guano are used on the farm annually, besides the large quantity of farmyard manure which Mr. Patton's system of farming allows to be made. Bone manure is applied to the vetches, as farmyard dung is found to be too strong, and causes waste of the crop. One part of the farm, consisting of about 20 imperial acres, being rather steep, and also inferior soil, has been laid down in grass for a time, but it will soon require to be broken up.

Mr. Patton was for many years a regular grower of flax, and his specimens of scutched flax were always certain to obtain a prize when exhibited at the shows of either the Royal Agricultural Society of Ireland, or of the Royal Dublin Society. He grew the flax crop after wheat, making the fourth year of half the break, grass seeds being sown with the flax, and as in the next rotation the flax was grown on the other half, it follows that flax was repeated on the same piece of land only once in 10 years. At present he has given up growing flax, from the uncertainty which has of late years attended the cultivation of the crop in its early stages. When he did grow flax the yield obtained by him was generally about 40 stones of scutched flax to the Irish acre—say about 25 stones per imperial acre—and the price ran from 13*s.* to 14*s.* per stone. Mr. Patton occasionally saved the seed of part of his crop for sowing, but found that it was not to be depended upon, the produce being sometimes as good as that of the foreign seed, while at other times it was much inferior.

Flax is a ticklish crop; not to grow, perhaps, in ordinary years, but to handle; and the fact that it must be brought to market in a partially manufactured state, that is, scutched, demands the greatest care and caution on the part of the grower throughout the different preparatory stages. The yield and price will be affected by the stage of growth which the plant has reached when it is pulled; the length of time it remains in the "steep-hole," the temperature, and colour or nature of the water, &c.; and ignorance of, or inattention to any material point, will result in the price of the scutched flax being reduced by 1*s.* to 2*s.* per stone, which is a serious matter when the acreable produce is considered. Farmers in the district about Glasslough are not growing so much flax now as they used to do, which arises partly from a feeling that the land has been overflaxed, and partly owing to the harsh, dry weather which has prevailed for some years past in spring and the early part of summer. This is supposed, and with justice, to encourage the development of the "flax-fly," an insect of much the same kind as the turnip-fly, which has proved very destructive, in some years, to the flax crop in Ulster.

Mr. Patton drills all his wheat 10 to 12 inches apart, which practice gives him a heavy sound crop, the land being clean and in high condition. Seed oats are also drilled, except when sown on lea. The produce of the wheat crop is usually 40 cwt. per Irish acre, the general average of the district being from 25 cwt. to 30 cwt. Mr. Patton has had 50 cwt. of oats off the Irish acre, the current yield of the district being from 30 cwt. to 35 cwt. Mr. Patton has grown the winter dun oat, a variety much cultivated in some of the south-eastern counties of Ireland; but although it yielded fairly, he has given it up, as the crop was very apt to be destroyed by wood-pigeons. Swedes and other turnips, also mangolds, are grown in drills (ridges) 30 inches apart and wide thinned. These crops are manured with farmyard dung at the rate of 20 to 25 tons, per imperial acre, assisted with bone manure and guano, say 3 cwt. per imperial acre. The weight of swedes has reached 64 tons per Irish acre, say 40 tons per imperial acre. All roots are taken up during November and the early part of December and stored in heaps, which are thatched with straw. The heaps are made in the rickyard, to be convenient to the houses.

About 16 imperial acres of run-out bog, that is, bog-land from which most of the peat has been cut away for fuel, have been added to the farm. It is usual that land of this description is given rent-free for some years, in order to be reclaimed. Mr. Patton has been growing potatoes and long red mangolds on part of the bog, and has a portion of it in grass, while the remainder, the last added, has been levelled and prepared for cultivation.

It has been intimated that Mr. Patton exhibited flax on many occasions with success; he has also been a regular and successful exhibitor of Ayrshire cattle, and of butter, and in fact has got more prizes than he can enumerate from recollection. Among others, he "won out" the "Ulster Challenge Cup," given by the North-east Association, which holds its annual shows at Belfast, for the best cow exhibited in the Ayrshire, Polled, or Devon classes, winning with Ayrshires, a breed which he has specially cultivated for many years, importing for the purpose from the herds of some of the best breeders of Ayrshires in Scotland. It may also be mentioned that for 12 years in succession, Mr. Patton's farm was awarded the prize given for the best cultivated farm in the district.

Ten to twelve milch cows are kept at Trynanny. The calves are all reared, unless when an Ayrshire cow has a bull calf, which it is not considered desirable to rear as a bull. The rejected calves are fed as veal, Ayrshire bullocks seldom growing to satisfactory weights. A few of the cows are crosses, chiefly of the Ayrshire and Shorthorn. These crosses are good milkers, but Mr. Patton prefers the pure Ayrshire. One of the latter belonging to him has produced as much as 17¾ lbs. of butter in one week.

The summer stock of cattle, old and young, consists generally of about 36 head; and, previous to winter, from 16 to 20 bullocks and heifers are bought in to be fattened. The cows are grazed on the pasture during summer, and while on the grass they get "a drink," which is composed of bean-meal, crushed oats, and bran—3½ lbs. to each cow—mixed with water. They have also vetches, &c., at any time when in the house during summer and autumn. The "drink" has a very decided effect on the milk and butter. During winter the cows get swedes or other turnips, and mangolds, one feed of each daily, sliced but never boiled; also the "drink" when the cows are in milk. The turnip flavour, which is usually so much complained of, is prevented by putting some of the already soured old milk among the new milk. This hastens the souring of the latter and prevents the formation of the flavour, which is greatly caused by allowing the milk to sour slowly. The whole milk is churned, as the butter made from whole milk is considered to have a better colour and flavour than butter produced by churning cream. The dairy is commodious, and, I need scarcely say, is kept invariably sweet and clean. It is heated in winter, when necessary, by a small stove. The churn used is a plunge churn, by J. and T. Young, of Ayr, and is driven by horse-power. Owing to Mr. Patton's success as an exhibitor of butter at the Irish shows, the butter made at Trynanny, by Mrs. Patton and her daughter, is in great request among private families in Dublin, Belfast, and Scotland, so that they can scarcely supply enough to meet the wishes of their customers. Mr. Patton reckons that milch cows return from 14*l.* to 16*l.* each per annum.

The calves are reared on milk, and some oatmeal gruel mixed with it. The fattening cattle, after being in the house for some time, get, in addition to a full supply of roots, from 5 lbs. to 6 lbs. each of a mixture of bean-meal and crushed oats, beginning with 2 lbs. of the mixture to each animal per day. At first this is given in a dry state, but, by the month of March, Mr. Patton damps the mixture with water, as he considers that roots by that time have lost some of their sap. He does not use cake, as he goes on the principle of using home-grown food, instead of purchased feeding stuffs, believing that he finds the best market for the produce of his farm, when he converts it at home into beef, butter, and pork, and there are generally half a score of pigs, crosses of Berkshire, feeding in the sties on the refuse of the farm and dairy. The small farmers of the district depend very much on their milch cows and pigs; and large pork markets are held weekly during the season in Armagh and other towns. The pigs are killed at home, and the carcases only are sold in the markets, from whence they are sent to Belfast, where they are cured.

The buildings on Mr. Patton's farm are very commodious, and, including an excellent dwelling-house, have all been built at the expense of the tenant. Owing to the sloping nature of the ground access is given to the upper stories from the outside at the back of the buildings. One of Young's fixed 2-horse thrashing machines, of which large numbers are to be met with throughout Ulster, makes excellent work; and Mr. Patton is well supplied with implements and machines of all kinds. Amongst these is one of Gray's double-furrow ploughs, which, with three horses, gets over as much ground in a day as two 2-horse ploughs; Young's (of Ayr) reaping and mowing machine, Dickson's turnip-cleaner by Hunter of Maybole, &c., &c. There are four work-horses on the farm, stout short-legged animals, and one young horse.

The wages of farm labourers run from 8*s.* to 9*s.* a week, and there is very regular employment in the district. Mr. Patton boards his regular labourers, and finds it more satisfactory than hiring those who have houses of their own, as he is thereby enabled to feed them better than they would be likely to fare if they supplied their own food.

It has been stated that the old fences have been levelled, and new fences made, and that the farm buildings have been put up by the tenant. A part of the land had been drained under the Board of Works before Mr. Patton got possession of the farm, but he completed the drainage at his own expense. The drains are 3½ to 4 feet in depth. He has also made a considerable extent of good farm roads, to give access to all parts of the farm: the gates are substantial, and the entire appearance of the place, and all that belongs to it, shows that minute attention is constantly bestowed on every detail of management.

Mr. Patton began life as a farmer on a holding of 11 Irish acres in extent, that is, about 18 imperial acres. He gradually acquired more land, paying as much in some instances as 18*l.* an acre for the tenant right, until he had got together a farm of about 42 statute acres, which is now held by one of his sons. This was irrespective of the farm of Trynanny, which was subsequently purchased as described above. He has brought up a family in a most respectable manner, and his success shows what an industrious, persevering, and intelligent man is capable of doing. Having had a large experience among small farmers, the opinion of such a man as Mr. Patton is of considerable weight, and in talking over the matter with him, I found that he considers 30 statute acres the smallest farm that a man should have to make a fair living out of it. In this view, most people who know the circumstances of the average run of small farmers in Ireland, will fully coincide.

Farms in Queen's County.

Mr. Dennis Dunne holds 75 Irish acres—121½ statute—in the townland of Coolroe, which is about 6 miles from Portarlington Station on the Great Southern and Western Railway. Mr. Dunne and his father occupied the farm for at least 50 years, without any lease, but about three years ago, a lease was granted by the landlord for 31 years at the former rent, namely 76*l.*, in consideration of the tenant having made a number of permanent and valuable improvements, without any assistance from the landlord. These improvements consist of a substantial set of farm offices; draining the farm 3 to 4 feet deep, broken stones being used in filling; making fences, reclaiming land, and keeping the farm generally in high condition by liberal manuring.

The system of cultivation followed by Mr. Dunne is (1) oats; (2) potatoes, swedes, and mangolds; (3 and 4) two crops of barley in succession, the land, in common with the district generally, producing excellent crops of barley; (5) young grass for hay, soiling, and pasture. Mr. Dunne has been frequently a winner of the county prize cup for the best barley. He manures heavily for his root crops, and besides the farm dung produced at the farmstead he buys annually 200 tons of dairy cow-dung, which is brought by canal from Dublin, a distance of over 40 miles. The station on the canal where the dung is unloaded is about two miles from the farm. In addition to the farmyard and

Dublin dung, Mr. Dunne applies 7 to 8 cwt. per Irish acre, say 5 cwt. per statute acre, of Lawes's superphosphate to swedes and mangolds. These crops were very good when I visited the farm, but the drills (ridges) were rather too close, considering the high condition of the land. The headlands, also, were not finished and cropped; and this, it may be remarked, is a very common defect in Irish farming, which should be attended to, as it often gives a slovenly appearance to a field which is otherwise all right. The grasses present a thick, close *sole*, and promise well for the future. Some cut-away bog in connection with the farm has been laid down as pasture, but the grass on it is poor. Mr. Dunne has a fixed 3-horse thrashing machine, but when his horses are otherwise engaged he hires steam. There are several travelling steam thrashing machines in the neighbourhood, which work for hire, and are very fully employed during the season. A few years ago the flail was the only thrashing machine used by many farmers in the district. Mr. Dunne's farm was at one time divided into 30 or 40 small fields, by the usual immense banks and hedges common in most parts of Ireland; but it is now in five fields, suitable to the rotation followed. The cut-away bog is not counted as part of the cultivated land. The hedges are kept properly trimmed; the gates are in working order; and the gateways into each field have been laid with stones and gravel, in order to prevent carts from cutting up the ground about them.

The live stock consists of six or seven milch cows, of a good sort of Shorthorn crosses. The calves are all reared, and kept until they are three years old, when they are fattened; and in addition, 12 to 15 bullocks are purchased at some of the October or November fairs to be fattened during winter. Half-a-dozen heavy pigs are also fattened at a time, and succeeded by others as the fat ones are disposed of. The farmyard is kept in neat order.

Mr. James Flynn's farm adjoins that occupied by Mr. Dunne. It consists of about 100 acres Irish, or nearly 162 imperial acres. The farm belongs to the gentleman who is Mr. Dunne's landlord, and Mr. Flynn holds it now by a similar lease to that granted to his neighbour.

The system pursued by Mr. Flynn is much the same as that described in connection with Mr. Dunne's farm, both as to cropping and manuring. The root crops were very good, although the produce of a second sowing, in the case of the swedes, the plants from the first sowing having been cut off by the fly. The drills, or ridges, were 28 inches apart, which was close enough for the luxuriance of the crop, particularly as the plants had been thinned only to a little over 10 inches apart.

In the county competition, however, which took place in November, following my visit to his farm, the crops being examined in the field, Mr. Flynn was awarded the first prize in his class for swedes, the weight of his crop, as reported by the judges, being 46 tons 19 cwt. per Irish acre, that is, about 29 tons per imperial acre. The crop was very clean, and the headlands, although not under crop, were perfectly free from weeds. Mr. Flynn is rather a formidable exhibitor in his class at the Queen's County cattle shows, and besides a number of medals he has carried off from these shows a large amount in money prizes.

The whole of the farm required draining, which has been done at the tenant's expense, together with the erection of such farm offices as he required.

His live-stock consists of 55 head of cattle of different ages, and 50 ewes, the lambs of which are mostly sold as butcher's lambs, some of the best ewe lambs being kept to replace old ewes. The sheep are of the pure Border Leicester blood, derived from the flock of Messrs. McLachlan and McCulloch, who occupy the farm of Bellegrove, in the same neighbourhood. A piece of improved bog land helps to keep the flock through the summer. Mr. Flynn also rears and feeds a number of Berkshire swine. His farm horses are of a useful class, and very different from the "weeds" that were so common in the district a few years ago.

Pat Clear occupies a farm of 8 Irish acres—13 acres imperial —in the townland of Rath, in the immediate neighbourhood of the two farms described above. The rent is 2*l.* an Irish acre, or 25*s.* per imperial acre. This little holding, including cottage and out-offices, yards, &c., is altogether a model of neatness. The soil is a nice loam, suitable for growing all kinds of crops usually cultivated. The root crops were good, and free from weeds when I examined them; headlands planted with cabbages; in fact, there was not a vacant spot on the farm. Hedges and gates were in good order. The young grass is topdressed with guano and compost, and part of it is cut early for soiling; hay is taken off the rest. Two acres are kept in permanent grass, as an outrun for the cows, &c. Pat Clear keeps two cows—sometimes three—and a horse, besides pigs and poultry, breeding a large number of the latter every year. His calves are fattened and sold as veal calves. He runs the grubber through his stubbles before ploughing for winter, so as to give the land an autumn cleaning. The crops are cut with the scythe. His rotation is oats, roots, barley, seeds. Pat Clear's holding is a very good illustration of what may be done by an industrious man on a small extent of land.

I have already mentioned the farm of Bellegrove, of which Messrs. McLachlan and McCulloch are the occupiers. This farm is part of the estate belonging to J. G. Adair, Esq., and has been held on lease by the present tenants for the last seventeen years. It consists of 650 statute acres—chiefly a limestone gravel loam, but with a considerable proportion of rough pasture. The better part grows good crops of wheat, barley, roots, and artificial grasses, but, in general, the soil is not suitable for permanent pasture. Black oats succeed better on the farm than any of the white varieties. Barley, however, is the principal cereal crop, and the barley grown at Bellegrove has reached 59 lbs. per bushel. As already mentioned, the district to which I refer at present is noted as a barley-growing district, and I find that the highest rate of produce is 20 "barrels" per Irish acre; that is, reckoning the bushel at 56 lbs., equal to fully 60 bushels per imperial acre; but the average yield in the district is reckoned at 13 or 14 "barrels" to the Irish acre, that is, about 43 bushels per imperial acre.

The fields on Bellegrove Farm are large, and suitable for the rotation followed, which is the ordinary four course, lengthened by two or three years' pasture, as may be convenient. Ten horses are kept for the work of the farm, and as two double-furrow ploughs are used, it is considered that these save one pair of horses and a man. The farm-steading is built of stone, and arranged on the plan commonly adopted on farms of the kind in Scotland. A fixed engine does the thrashing and other barn and feeding-house work.

Sheep form a principal part of the live-stock at Bellegrove. The breeding flock consists of from 300 to 350 ewes, of Border Leicester blood. Messrs. McLachlan and McCulloch imported a few years ago a number of high-class ewes from Kelso, and since that time rams have also been brought over. Previous to the introduction of the Border Leicesters, the flock at Bellegrove consisted chiefly of "English Leicesters," but it was found that the sheep became rather fine, and the Border Leicester was resorted to, in order to get more size without injuring quality. For some years Messrs. McLachlan and McCulloch were successful exhibitors of sheep at the Irish Royal, and the Royal Dublin, as well as local shows, but, latterly, they have given up showing, finding, as others have done, that show condition is not always favourable to breeding. Besides the breeding flock, there is also the fattening flock, which consists of each year's "crop" of lambs—say 400—which are fattened during winter for the Dublin market. These are folded upon the crop, or a part of it, and the turnips are all cut by a machine for the sheep. Half a pound of oats and cake is given to each hogget daily, and as much hay as they can consume. The hoggets are, usually, sold when shorn—say in April and first week of May—but some of those which are soonest ready go off in the fleece in the month of March, and even earlier. Out of the wool they bring from 50*s.* to 63*s.* each, and their fleeces weigh from 8½ to 9½ lbs. Before the tenants of Bellegrove got their flock fully up in numbers, they were in the habit of purchasing a number of hoggets at the spring fairs at Kilkenny. The sheep bred in the Kilkenny district are not so fine as the Leicesters, nor do they fatten quite so readily. The best of the ewe hoggets bought at Kilkenny were selected and put to a Lincoln ram, while the remainder, after a summer's run on grass, were fattened on turnips. The produce of the Kilkenny ewes, with the Lincoln cross, were also fattened, none of them being kept as stock sheep. It was found that the Lincoln cross gave size and wool to the lambs, but the quality of the sheep was not equal to the Leicester, or even to the produce of a pure Leicester ram with Kilkenny ewes.

From fifty to sixty head of cattle are fattened during winter in the stalls, and some young store cattle run in the yards. During summer, forty or fifty cattle, Kerries, and other light beasts, are grazed on some of the coarser pasture fields. The beasts intended for the stalls are usually purchased at the October fairs; they are fed on turnips and straw until about six weeks of being finished, when they get each a daily ration of artificial food, consisting of 3 lbs. of crushed oats, 3 lbs. of crushed barley, and 2 lbs. of cake, all mixed, which is continued until they go to the market. Some years ago the tenants of Bellegrove fattened more cattle than they have done latterly; but the decrease in cattle has been made up by a corresponding increase in the number of sheep kept on the farm, and, considering the nature of the land, the slight alteration which has been made in the management is certainly an improvement.

Wages in the district range as follows:—Ploughmen, 10*s.* a week, with free house and fuel (turf); ordinary labourers, 10*s.* per week, and during harvest 3*s.* per day; women, 1*s.*, and during harvest 2*s.* 6*d.* a day. The harvest wages are calculated without food.

It is right to state that Queen's County has the advantage of possessing a number of resident landlords, who take a lively interest in promoting agricultural improvements. This circumstance has proved of immense service to Queen's County and County Kildare, especially that portion of the latter which adjoins Queen's County, forming part of the estates belonging to his Grace the Duke of Leinster, and those districts have improved more of late years than almost any other in Ireland.

The farmers are generally a very intelligent class, and take readily to improvements in management. The discussions at the meetings of the Athy Farmers' Club are quoted in every agricultural journal throughout the kingdom. The town of Athy is in Kildare, but it just borders on Queen's County, so that it may be considered in a great measure as the centre of the improved district.

XVI.—*Agricultural Education in Ireland.* By R. O. Pringle, Editor of 'The Irish Farmers' Gazette.'

Having in a previous paper* referred to the Agricultural Department of the National Board of Education, as a medium through which much valuable "technical education," relating to the principles and practice of improved systems of agriculture, is being disseminated among the peasantry and medium-class farmers of Ireland, I shall now give some account of the origin and working of that department.

The utility of affording useful instruction in agriculture to the small farmers and peasantry of Ireland has been urged for a very long period. Thoughtful Irishmen, who knew the backward state of Irish agriculture, could not fail to perceive the great importance of instructing the people in this branch of industry; and Parliamentary Committees and Royal Commissioners had over and over again reported in favour of it. Thus, the Select Committee of the House of Commons, in 1823, in their report, said—"Your Committee cannot but think that this instruction in industry might be most advantageous to the public;" and the Select Committee of 1830 reported that—"The advantage of combining instruction in the arts of industry with religious and literary instruction is much and properly dwelt on by many witnesses. This recommendation is also supported by the authority of Mr. Locke and Mr. Pitt."

It was in the year 1831 that a commencement was made with the present system of National Education in Ireland. At a very early period in the history of the movement, we find the Commissioners acknowledging the utility of diffusing among the people correct information on the subject of agriculture, and stating their willingness to supply it; they appear, indeed, to have taken it up earnestly as far back as 1838.

At first they confined their efforts principally to the establishment of a school of agriculture, at Glasnevin, near Dublin,

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* 'Journal of the Royal Agricultural Socitye,' 2nd Series, vol. viii., Part I., No. 15, p. 28.

where they took a moderate-sized farm, and erected upon it suitable offices. Two classes of persons received instruction:—First, the schoolmasters, trained in the Normal Training Establishment in the city, who went out to the model farm regularly for instruction, the object being to qualify them to teach agriculture in their several districts, when they returned to their own schools. Second, a number of young men, who were received as agricultural boarders, and trained as professional agriculturists, in the hope that they would afterwards be employed by the landed gentry of the country in instructing their tenants.

The Commissioners were engaged in pursuing their system of agricultural instruction, when at the end of 1843 the Royal Commission, known as the Devon Commission, was appointed, and proceeded to make a searching inquiry into all matters relating to the agricultural interests of Ireland. Landed proprietors, land-agents, practical farmers, and professional men acquainted with the state of Ireland and interested in promoting its prosperity, were examined. It is remarkable that, to use the words of the "Digest" of the report of the Devon Commission, "There appears to have been no difference of opinion amongst the witnesses, as to the advantages to be derived from an extended establishment of agricultural schools."

The favourable way in which agricultural schools were mentioned in the report, and the strong evidence given in their favour by the witnesses, naturally assigned to them a high place among the agencies for mitigating the evils of the famine, and preventing a recurrence of it. One or two references will show how deep a hold the question took on the gentry at the time.

The empire has produced few men who were supposed, and with good reason, to understand the wants of Ireland better than Lord Mounteagle. When at the zenith of his influence, he addressed a remarkable letter to the Commission embodying suggestions for the establishment and government of agricultural schools. This document will be found in the Report of the Commissioners of National Education for 1847, and it contained the following passage:—"It is wholly unnecessary to dwell on the importance of agricultural education. But I may be permitted to observe that what, before the blight of the potatoe, was a matter of undeniable usefulness, is now, by this casualty, made a matter of indispensable necessity; we are called upon *under the penalty of famine* to teach our people modes of cultivating better crops."

The Royal Agricultural Improvement Society of Ireland had by this time been established, and the list of members included a large number of the nobility and gentry of Ireland. In the second number of the Quarterly Journal, which was issued for a time under its auspices, appeared an able paper on Industrial Education, from which I take the following passages:—" Every national school in Ireland should be an agricultural school, if situated in a rural district; every schoolmaster in Ireland, every functionary of education, should be impressed with, and inculcate the one idea, that the gangrene of Irish society is absence of practical principles . . . . . It is our belief in the honest anxiety of the Board of Education to increase the efficiency as well as the number of their schools, that emboldens us to call upon them to establish the industrial character of the instruction they give."

The original idea of the Education Commissioners, when they embarked in agricultural education, was to blend agricultural with literary instruction, in as many of the rural national schools as possible. But, urged on by the gentry, they were induced to enlarge their plans. Applications were made to them from all parts of the country for aid towards establishing agricultural schools of a more comprehensive class, than they at first contemplated. In their report for 1849, they say:—" We have, during the past year, received a considerable number of new applications for grants towards the establishment of model agricultural schools. We have found it necessary to postpone our decision upon twenty of these applications." Ultimately, the Commissioners yielded to the appeals made to them, and established, solely at the public expense, in various parts of the country, a number of model agricultural schools.

There are now in operation throughout Ireland, seventeen of these model schools, exclusive of the Albert Institution, at Glasnevin. From a variety of causes, it happened that for several years the farms attached to these schools did not pay; and this circumstance nearly brought the whole proceedings of the Board into disrepute. This state of matters, however, has latterly been altered for the better.

The landed gentry of Ireland became so satisfied with the model agricultural school, and model farm system, that for a time the original notion of blending agricultural with literary instruction in ordinary rural national schools was neglected. It was not, however, abandoned by the Board; they encouraged it, although with varying success. The number of this class of schools went down to thirty-nine, in 1861. It then began to revive; and the number now in operation is one hundred and fifteen; the total cost to the State for the agricultural instruction afforded in these schools, is 5*l.* per school. The total number of boys who receive this agricultural education is about 4200, which makes the cost about 3*s.* per head. In addition, there are sixteen national schools, which rank as model agricultural schools, under local management. In fifteen of these the teachers receive each 10*l*. per school for agricultural instruction; and in the case of Loughashe, the largest and most important of the class, the grant is still larger. There is surely not an intelligent person in the United Kingdom who can object to the insignificant outlay of the Board of Education for so useful an object as the diffusion among the Irish people of sound agricultural knowledge.

It may be said that there is less want of this sort of knowledge now than there was when the Board first embarked in agricultural education. But it must be borne in mind that the agricultural practice of the vast majority of Irish small farmers is still deplorably deficient. Englishmen who have not been in the remote parts of Ireland find it difficult to realise the state of the country, or the necessity of State instruction in agriculture. In England, the great proprietors who reside on their estates generally set a suitable example of farm management on their home farms. This is, no doubt, also the case to a certain extent in some parts of Ireland; but in the backward districts the proprietors are for the most part absentees, and the national schools and the clergy are the only agents of civilisation. In England the farms are large; but in Ireland, as I have shown, there are about half a million of occupiers not one of whom holds over thirty statute acres. About two-thirds of these belong to the class denominated small farmers. There are still in Ireland 360,000 agricultural holdings, not one of which is valued for purposes of government taxation at more than 10*l*. per year. Can there be any grounds whatever for doubting the utility, and, in fact, the necessity, of instructing the greater number of these persons in better modes of husbandry? Is it not both the duty and the interest of the State, to use the national schools as the medium of conveying agricultural instruction, more especially in those remote districts of the South and West, which are inaccessible to any other agent of agricultural progress?

There are thirteen national schools in the county of Donegal in which combined agricultural and literary instruction of the character now described is afforded. The agricultural element costs the State 5*l*. per school; can any person question the wisdom of the Commissioners in encouraging this species of education, at so trifling a cost, in that remote and wild region? In the province of Connaught there are forty national schools in which agricultural and literary instruction is combined in the same way. There are six of these schools on one estate, the rental of which is 28,000*l*. per annum, and on which there are 4500 tenants, who each pay on an average about 6*l*. of rent per year. When the Commissioners began to make grants for agricultural instruction, the rotation of crops was scarcely known amongst the small farmers on this vast estate. Now the knowledge of the rotation of crops is extending; the growth of root crops, and of artificial grasses, is also increasing; and in due time correct ideas on all subjects relating to the proper cultivation and management of their holdings will prevail among the people.

The Commissioners are anxious to increase very considerably the number and efficiency of this class of schools, and they confidently hope the Treasury will enable them to carry out their views. They are of opinion that all persons who are competent to form a correct opinion on this subject will applaud their efforts, and agree with the late Lord Palmerston, who in a speech delivered in the House of Commons, used these words:—"There could not possibly be a better application of money in Ireland, than in teaching the peasantry and small farmers how best to cultivate the soil, for they did not know how to realise, to the best account, the natural resources which lie undeveloped in the soil they tread."

Having said so much with reference to the rural schools, I shall now make a few remarks on the Glasnevin or Central Agricultural Institution of Ireland.

At the outset the great difficulty the Commissioners had to contend against was the want of teachers combining sufficient knowledge of improved farming with the ordinary qualifications of literary teachers. To supply this want, it manifestly became necessary to establish a model farm, and a school in the neighbourhood of Dublin, where the teachers would be trained in this new branch of education. This was the primary object of the Glasnevin Agricultural School. The Commissioners are now training in this central Institution 180 teachers every year. These teachers receive systematic lectures on the theory and practice of improved agriculture, and they see theory reduced to practice on the farm at Glasnevin.

But while that institution was founded primarily for the instruction of the schoolmasters, the Commissioners, from the outset, made it available for the agricultural education and training of farmers, farm bailiffs, and estate agriculturists. The plant having been provided, it seemed to them wise and right to use the school for conferring benefits on as many pupils as possible. The machinery of the national system enabled the Commissioners to bring up from the provinces promising young men who evinced a decided taste for agriculture. To these they have endeavoured to afford sound instruction in modern farming, and training in agricultural practices. Of the young men so educated and trained, some have emigrated, as might be expected, but the majority remain in the country, and are now occupied in farming for themselves, or as farm-bailiffs, or in instructing the tenants on certain large estates.

Objections have been raised, occasionally, against the system of having young men trained by the State to become farm bailiffs or agriculturists for landed proprietors; but such objections have emanated from persons who were unacquainted with the state of Ireland. It is to be borne in mind, that the system of national education was founded for the benefit of the mass of the population, and the Commissioners believed it was their duty to aid and encourage every young man of talent and promise to advance himself, for they knew that in advancing himself he must benefit the State. Hundreds of intelligent, well-educated men, trained at the Glasnevin Agricultural Institution, are now centres of enlightenment in their respective districts; and the Commissioners are of opinion that none of them are repaying the State for the cost of agricultural instruction so thoroughly as those who are acting as estate agriculturists, advising, instructing, and directing tenants of great landlords. Of the importance of that class of estate officials, I have already written fully; and I must say that if the landed gentry of Ireland understood their interests, they would employ in this capacity every talented deserving man who had been trained at Glasnevin.

In the improved circumstances of Ireland, many of the young men who now seek admission to the Glasnevin Agricultural School are the sons of persons who are able to pay a moderate fee for the education of their children. Accordingly, the Commissioners insist that persons of this class shall pay a fee of 20*l.* a year, for the agricultural training afforded to them at the institution. The greater number of the pupils are, however, those who are boarded and educated wholly at the public expense, and who are admitted by competitive examination, as suggested in 1860, by the Right Hon. E. Cardwell, then Chief Secretary for Ireland.

In addition to the system of agricultural instruction referred to in the foregoing remarks, the Commissioners are now diffusing agricultural knowledge in many of the rural schools, which do not rank as agricultural schools at all, through the medium of an agricultural class-book. At the outset they published a work of this kind, but it had got behind the enlarged requirements of the schools, and in 1867 they issued a new book of a more comprehensive character, which has been favourably received by the public, and of which upwards of 50,000 copies have been already sold through the national schools. The Commissioners are anxious that this book, or such other works on agricultural industry as they may sanction, should be read at least twice a week in all their schools.

I have refrained from introducing into these remarks on the

Irish agricultural schools, certain statistics which would have shown the progress made of late years; but I trust enough has been said to prove that the agricultural system of the Irish National Board of Education eminently deserves the continued support of the State; more especially now that it has been purged from those elements which formerly were detrimental to its usefulness.

XVII.—*On Australian Concentrated Mutton-soup as a Food for Pigs.* By Dr. AUGUSTUS VOELCKER, F.R.S.

ABOUT eighteen months ago a short communication from a gentleman, writing from Adelaide, South Australia, appeared in the 'Agricultural Gazette,' directing the attention of pig-feeders to a new article of food, which can be procured in considerable quantities from Colonial establishments where sheep are boiled down for tallow.

In such establishments the liquor obtained by boiling out the meat and bones of sheep after removal of the tallow, is either allowed to run to waste altogether, or it is made into a compost manure, for which, however, there does not appear much demand in the Colonies.

In order to prevent this waste, it occurred to a gentleman who is largely engaged in Australia in boiling down sheep for tallow, to make some experiments, with a view to convert this waste liquor, or, as it may be termed, this rich mutton-broth into food; and he has succeeded in producing a new article of food, which he calls "Concentrated Mutton-soup," and of which he makes two qualities. The first quality is made for human food, and the second is specially recommended for pigs or dogs. It appears that from 60,000 to 100,000 sheep boiled down for tallow during the season, from August to February, about 1 lb. of concentrated mutton-soup of first quality, and 2½ lbs. of second quality are obtained per sheep.

Samples of the first quality for human food, as of the second quality recommended for pigs and dogs, have been submitted to me for examination. The former has a nice savoury smell and taste, and is sent in tins from Australia to England in the shape of a thick, stickey, brown-coloured extract. This extract is only partially soluble in cold water, but dissolves perfectly in boiling-water, with which it forms a perfectly clear light-brown coloured and agreeably tasting solution. Seasoned with a little pepper and salt, the soup thus made is a good, wholesome, and nutritious mutton-broth.

The analysis of this essence of mutton for human food yielded the following results:—

Composition of Essence of Mutton or Concentrated Mutton-soup for Human Food.

Water	29·20
* Organic matter	60·48
Mineral saline constituents	10·32
	100·00
* Containing nitrogen	8·68

The extract of mutton differs in character from Liebig's Extract of Meat, which is prepared by expressing the meat-juice with the addition of a little cold water, and concentrating the juice thus obtained by evaporation in steam-jacketed vessels. Liebig's Extract of Meat being obtained by cold pressure, contains no appreciable quantity of gelatine, but it is richer in true meat-juice and extractive matters, soluble in alcohol, and contains less water than the Australian Essence of Mutton, which is prepared by boiling out the meat and bones of sheep with water, and evaporating the strained, clear liquid to the consistency of a thick extract; it contains a considerable quantity of gelatine, which renders the extract firmer than Liebig's Meat Extract. Notwithstanding the firmer condition, the Australian Essence of Mutton contains about 10 to 11 per cent. more water than Liebig's Extract of Meat.

The physiological effects and the commercial value of extract of meat depend principally upon the percentage of extractive matters, soluble in alcohol, which different samples contain. In examining meat extract, the amount of the constituents soluble in alcohol should always be determined, if it is desired to obtain a true insight into its quality. The Australian Essence of Mutton I found contained 33·51 per cent. of extractive matters soluble in alcohol, containing 80 per cent. of absolute alcohol. Liebig's Extract of Meat yields on an average about 60 per cent. of constituents soluble in alcohol, of 80 per cent. strength, and contains nearly twice as much saline matters as the sample of Australian Concentrated Mutton-soup, the analysis of which is given above. Although the latter is thus inferior to Liebig's Extract of Meat, it is cheaper, and contains a large amount of extractive matter, and with the addition of proper seasoning makes very good mutton-broth.

Concentrated Mutton-soup as a food for pigs and dogs:—The extract prepared for the use of pigs and dogs was sent from Australia in wooden kegs containing about 32 lbs. each. It possessed somewhat more consistency than the first quality for human food, and had a more gluey and less savoury taste than the latter. In a dry, well ventilated place, the extract may be kept for any reasonable length of time, without becoming mouldy or otherwise deteriorated in quality. Of the two samples of this extract, the first was not quite so thick as the other, and contained rather more water, as will be seen by the following analysis:—

Composition of First Sample of Australian Concentrated Mutton-soup.

Water	31·29
Fatty matter	·35
* Nitrogenous organic matters (gelatine and meat-extract)	64·27
Saline mineral matter (ash)	4·09
	100·00
* Containing nitrogen	10·75

It therefore appears that the Extract of Mutton has been deprived almost entirely of fat; but that it is particularly rich in nitrogen, a large proportion of which was present in the form of gelatine. The extract dissolved entirely in boiling water, forming with it a clear, brown-coloured and agreeable tasting liquid. On the addition of strong alcohol to a concentrated solution of the extract, most of the gelatine was precipitated in thick flakes. By treating the extract with alcohol of 80 per cent. absolute alcohol I obtained:—

Dry extractive matter, soluble in alcohol ..	20·27
Dry constituents insoluble in alcohol	48·44
Water	31·29
	100·00

In round numbers this sample contained about one-third the amount of real meat-extract which is found in Liebig's Extract of Meat. The remainder of the solid constituents consisted chiefly of gelatine or glue.

The second sample of Concentrated Mutton-soup for pigs and dogs was slightly less firm than the preceding sample, and an analysis yielded the following results:—

Composition of Second Sample of Concentrated Australian Mutton-soup.

Water	29·70
* Nitrogenous organic matter	66·29
Mineral matter (ash)	4·01
	100·00
* Containing nitrogen	10·96

On treatment of the extract with alcohol of 80 per cent. I obtained :—

Dry constituents soluble in alcohol	17·89
" insoluble in alcohol	52·41
Water	29·70
	100·00

The preceding analytical results show that the second sample contained rather more gelatine, but less extractive matters soluble in alcohol, than the first. No perceptible difference was noticeable in the appearance and general characters of the two samples.

Both the samples prepared for the use of pigs, it will be seen, contained a much smaller percentage of saline substances and extractive matters soluble in alcohol than the first quality prepared for human food. In all probability the best quality is obtained by moderately boiling out the best pieces of mutton, rich in meat-juice, and the second quality by further and prolonged boiling out of the partially exhausted meat, together with the more cartilaginous portions of the carcase.

Considering the composition of the Essence of Mutton, and the inviting and savoury soup which may be made from it by dissolving the extract in boiling water, it can scarcely be doubted that this food has a considerable feeding value, and will be greedily devoured by pigs. The question, however, arises, is it worth the money at which it will have to be sold in England, so as to leave a fair profit to the importer, after defraying the cost of manufacturing the extract in Australia, freight, and trade expenses. I am informed that the Concentrated Mutton-soup for pigs and dogs will probably have to be sold in England at about 25*l.* a ton, which appears to me rather a high price in comparison with the cost at which other concentrated articles of food for pigs can be obtained. It is possible, however, that the essence of mutton may have the effect of facilitating the assimilation of other food, and in consequence have a greater nutritive value than it would appear to possess in virtue of the amount of nitrogenous food constituents which it furnishes to animals fed upon it. Questions of this kind can be satisfactorily settled in one way only, namely, by a series of well-planned, practical feeding experiments. I am glad, therefore, that my friend Mr. C. Gay Roberts, of Shottermill, Haslemere, undertook to give the Australian Mutton Extract as extensive a trial as the limited quantity of the food placed at his disposal would allow.

The following experiments were tried upon six pigs, divided into two sets of three pigs each.

The pigs Nos. 1, 2, 3, 4, 5 were all of one farrow, but No. 6 was of a different farrow, in consequence of which No. 6 was attacked by its companions, Nos. 4 and 5, and so severely bitten that it was necessary to remove it at noon on the 28th of December.

At the commencement of the feeding experiment, on the 22nd of December, 1871, the weight of each of the six pigs was carefully taken:—

First Experimental Lot.

		lbs.
No. 1.	Sow pig (chalked) weighed	119
,, 2.	Boar pig .. .. ,, ...	105
,, 3.	Boar pig .. .. ,, ...	91
	Total weight of three pigs of first lot ..	315

Second Experimental Lot.

		lbs.
No. 4.	Boar pig (chalked) weighed	112
,, 5.	Sow pig .. .. ,, ...	108
,, 6.	Boar pig .. .. ,, ...	101
	Total weight of three pigs in second lot	321

Both lots were fed upon malt-dust and palm-nut meal. As additional food the pigs in Lot I. received the Concentrated Mutton-soup, of the composition of the sample No. 1, mentioned in page 414, and for which was substituted English grown peas to Lot II.

Two tubs were set aside for feeding, each containing 28 lbs. of boiled malt-dust, and 14 lbs. of palm-nut meal.

Equal quantities of food were given from these two tubs to each lot of pigs respectively, beginning 4.30 P.M., 22nd December, 1871.

The pigs Nos. 1, 2, and 3 in the first lot received, in addition to their daily allowance of the above food, 1½ lb. of essence of mutton, or Concentrated Mutton-soup, dissolved in 4 pints of water, which was given daily to the three pigs each afternoon, with their second feed of malt-dust and palm-nut meal.

The pigs Nos. 4, 5, and 6, in addition to the same allowance of malt-dust and palm-nut meal which was given to Lot I., received 3 lbs. of English-grown peas in addition, or 1 lb. per pig daily.

The stated quantities of malt-dust, palm-nut meal and peas appeared sufficient for the pigs Nos. 4, 5, and 6 in the second lot, though they would probably have eaten more if it had been given them.

The pigs Nos. 1, 2, and 3 appeared restless and hungry, and it was seen at once that the food given to the first lot was insufficient to keep them in a comfortable and thriving condition.

1½ lb. of essence of mutton it thus appears was not a sufficient substitute for 3 lbs. of peas.

The food in each tub was consumed at the morning meal on the 29th of December, and the pigs were weighed at 12 o'clock on the same day.

LOT I.

	Live Weight On 22nd Dec. (When Experiment was begun.)	Live Weight On 29th Dec.	Loss.
	lbs.	lbs.	lbs.
No. 1. Sow pig (chalked)	119	115	4
,, 2. Boar pig	105	102	3
,, 3. Boar pig	91	87	4
Total	315	304	11

LOT II.

	Live Weight On 22nd Dec.	Live Weight On 29th Dec.	Gain or Loss.
	lbs.	lbs.	lbs.
No. 4. Boar pig (chalked)	112	115	3 gain.
,, 5. Sow pig	108	110	2 gain.
* ,, 6. Sow pig	101	100	1 loss.
Total	321	325	4 gain.

* Attacked by the other two pigs, and removed on the 28th December.

The food eaten in seven days by No. 1, 2, and 3 pigs in Lot I., was :—

	s.	*d.*
28 lbs. malt-dust, costing at 4*s.* per cwt... ..	1	0
14 lbs. palm-nut meal, costing 8*l.* a ton	1	0
10½ lbs. essence of mutton, at 25*l.* a ton	2	4
Total cost of food	4	4

The result produced was a loss of 11 lb. of flesh, worth 5*s.* 6*d.*

The food eaten in seven days by No. 4, 5, and 6 pigs in Lot II. was :—

	s.	*d.*
28 lbs. malt-dust, at 4*s.* per cwt.	1	0
14 lbs. palm-nut meal, at 8*l.* a ton	1	0
21 lbs. peas, costing 42*s.* per qr.	1	9
Total cost of food consumed	3	9

The result of the experiment was a gain of 4 lbs. of flesh, worth 2*s.* If, however, No. 6 pig had not been attacked by its companions, we may assume that it would have increased 2½ lbs., and the result would have been a gain of 7½ lbs. of flesh, worth 3*s.* 9*d.*

The palm-nut meal used in these experiments was obtained from Messrs. Alex. Smith and Co., Liverpool, who sell it by the following guaranteed composition:—

Moisture	5·92
Oil and fatty matters	20·01
* Albuminous compounds (flesh-forming matters) ..	13·87
Mucilage, sugar, and digestible fibre	38·24
Woody fibre (cellulose)	18·56
Mineral matter (ash)	3·40
	100·00
* Containing nitrogen	2·22

Malt-dust, according to Messrs. Lawes and Gilbert, contains in 100 parts:—

Moisture	6·24
* Albuminous compounds	25·83
Sugar, starch, and woody fibre	59·23
Mineral matter (ash)	8·70
	100·00
* Containing nitrogen	4·10

As far as these experiments go, it appears that the food given to Lot I. was incapable of maintaining the original live weight of the pigs, which were fed upon a limited supply of malt-dust and palm-nut meal, to which essence of mutton was added in a quantity which cost rather more than the addition of peas to the same amount of malt-dust and palm-nut meal, upon which Lot II. was fed. Under these circumstances peas produced a much better result than the Concentrated Mutton-soup.

It appears from these experiments that essence of mutton cannot be economically employed as a substitute for peas, nor doubtless for similar material when pigs are kept upon an insufficient amount of food, which it is desired to complement by some other article of food.

However, it is quite possible that when pigs are supplied with as much ordinary food as they can consume, an additional limited quantity of the Concentrated Mutton-soup may have a more beneficial effect, and more than repay the cost of the soup, when it is given to pigs rather with a view to promote the digestibility and assimilation of an excess of ordinary pig-food, than with a view to make up the deficiency of the needful amount of food to keep the animals in a thriving condition. I was anxious to ascertain whether the extract of mutton given to pigs, abundantly supplied with nutritious food, has really a beneficial effect upon the assimilation of the food, or whether the supposed value of the extract as pig-food amounts to nothing more than a theoretical speculation, unsupported by actual experience. At my suggestion Mr. Roberts, therefore, made another set of experiments, well calculated to throw light on this subject. Four home-bred pigs of one litter, about nine months old, and all males, were troughed at 11 A.M., on the 30th December, 1871:—

	lbs.
No. 1 weighed	107
„ 2 „	77
„ 3 „	102
„ 4 „	82

All the pigs were fed upon malt-dust, palm-nut meal, and peas, and the pigs Nos. 1 and 2 received in addition Concentrated Mutton-soup, whilst the second pair had no additional food.

Two tubs were set aside for the feeding experiments. The first contained the following food for Nos. 1 and 2 pigs:—28 lbs. of malt-dust boiled, 14 lbs. of palm-nut meal, and 14 lbs. of essence of mutton dissolved in boiling water. The second tub, for pigs Nos. 3 and 4, contained 28 lbs. of malt-dust boiled, and 14 lbs. of palm-nut meal, and no extract of mutton.

To each pair of pigs 2 lbs. of whole peas were given at midday daily, and they received as much as they could eat of the prepared food from the two tubs every morning and evening. Both the tubs were finished at the evening meal on the 6th of January, 1872, and the pigs were weighed at 4 P.M.

The tubs were refilled, that for pigs Nos. 1 and 2, with 28 lbs. of malt-dust, 14 lbs. of palm-nut meal, and 11 lbs. (the remainder of the keg) of Concentrated Mutton-soup, and the second tub with the same amount of food minus the mutton extract.

On the 15th of January the contents of both tubs were consumed at the morning meal, and the little keg of Concentrated Mutton-soup being consumed, each tub was refilled with 28 lbs. of malt-dust and 14 lbs of palm-nut meal.

The pigs were weighed on the 17th of January, at 4 P.M.:—

WEIGHT OF FIRST PAIR OF PIGS (fed upon Malt-dust, Palm-nut Meal, and Mutton Extract).

	Live Weight			
	On 30th Dec. 1871. (When Experiment was begun.)	On 6th Jan. 1872.	On 17th Jan. 1872.	Gain in 19 Days.
	lbs.	lbs.	lbs.	lbs.
No. 1. Pig weighed	107	114	125	18
„ 2. Pig „	77	83	89	12
Total	184	197	214	30

WEIGHT of SECOND PAIR of PIGS (fed upon Malt-dust, Palm-nut Meal, and Peas, and no Mutton Extract).

	Live Weight			Gain in 19 Days.
	On 30th Dec. 1871.	On 6th Jan. 1872.	On 17th Jan. 1872.	
	lbs.	lbs.	lbs.	lbs.
No. 3. Pig weighed	102	106	109	7
„ 4. Pig „	82	87	92	10
Total	184	193	201	17

During the nineteen days the pigs No. 1 and No. 2 consumed :—

	s.	*d.*
62 lbs. malt-dust, costing 4*s.* per cwt.	2	$2\frac{1}{2}$
31 lbs. palm-nut meal, at 8*l.* a ton	2	$2\frac{1}{2}$
38 lbs. peas, at 42*s.* per quarter	3	2
25 lbs. of concentrated Australian mutton-soup, at 25*l.* per ton	5	6
Total cost of food consumed by first pair of pigs in 19 days	13	1

The second pair of pigs consumed in the same period :—

	s.	*d.*
62 lbs. malt-dust, at 4*s.* per cwt.	2	$2\frac{1}{2}$
31 lbs. palm-nut meal, at 8*l.* a ton	2	$2\frac{1}{2}$
38 lbs. peas, at 42*s.* per qr.	3	2
Total cost of food consumed by second pair of pigs in 19 days	7	7

When sold the pigs realised 6*d.* per lb. live weight.

The first pair, it will be seen, gained in nineteen days 30 lbs. of flesh worth 15*s.*, at a cost of 13*s.* 1*d.*, and gave thus 1*s.* 11*d.* clear profit. The second pair gave an increase of 17 lbs., worth 8*s.* 6*d.*, at a cost of 7*s.* 7*d.*, leaving a clear profit of 11*d.*

In the second set of experiments the mutton-soup had a much better effect than in the first, in which an equal money value of the mutton extract was used to replace a given quantity of peas. In the second set both pair of pigs received the same quantity of palm-nut meal, malt-dust, and peas, and the addition of the mutton extract to the food given to the first pair entailed not only no loss as in the preceding set of experiments, but produced a better money return in live weight than without that addition.

It is much to be regretted that a further supply of the Australian Mutton Extract could not be obtained, for, as far as the trials go, they show that under certain conditions the Concentrated Mutton-soup is of considerable value as pig-food, and it appears very desirable to ascertain, by a more prolonged series of experiments, whether this new food can really be employed economically for the purpose of increasing the assimilation and value of ordinary feeding stuffs upon which pigs are usually kept. Probably it will be found that the mutton extract is not a food which, like barley-meal or peas, supplies to the animal body in a direct manner the necessary amount of albuminous compounds, starch, and other food-constituents required for the formation of muscle and fat, and supporting respiration, but that it exerts a useful physiological function in the elaboration of ordinary food. It has been pointed out that Concentrated Mutton-soup contains from 18 to 20 per cent. of real meat extract, soluble in alcohol. From the constituents of this meat extract chemists have already isolated kreatin, sarkin, and carnin, three well-defined organic compounds, belonging to the group of organic bases or alkaloids. Another organic constituent of meat extract is a modification of lactic acid, and there are, no doubt, other organic compounds in the juice of meat, which as yet have not been isolated. Besides the basic and acid organic compounds, extract of meat contains a large proportion of phosphate of potash and other saline matters, and thus possesses a highly complex composition. Although but little is known with regard to the precise physiological functions of the various constituents of meat extract, our present experience tends to indicate that meat extract materially assists in the assimilation of food, and in consequence possesses a certain physiological and possibly economic value.

11, *Salisbury Square, Fleet Street*, 28*th July*, 1873.

XVIII.—*On Foot-and-Mouth Complaint of Cattle and other Animals; with Remarks on the general characters of the disease and the causes which led to its recent extensive prevalence in this kingdom.* By G. T. Brown, Chief Inspector in the Veterinary Department of the Privy Council and Professor of Physiology and Therapeutics in the Royal Veterinary College.

History of Foot-and-Mouth Disease.

Epizootic aphtha, eczema, or foot-and-mouth distemper, is well known in this kingdom; its origin, like that of infectious and contagious disorders in general, is wrapped in mystery. Obviously it had a beginning, and the first animal attacked could not have taken the disease from a previously affected animal; but of the causes under which it first arose, we know no more than we know of the origin of evil.

The fact is admitted that foot-and-mouth disease is highly contagious; it can be certainly communicated by association of diseased with healthy animals; and the direct or indirect conveyance of the poison which is contained in the secretions, especially in the saliva, to a healthy animal, usually produces the disease. In the absence of the specific virus, however, no combination of causes has been known to occasion the malady; and it is therefore unreasonable to assume that hardships of any kind are capable of inducing it. Outbreaks commonly occur in situations where no direct or indirect contact with diseased animals can be traced, but the same statement applies with equal force to all forms of contagious and infectious disease of man and animals: the difficulty must be accepted as real, and if it is necessary to assume something, in order to explain the occurrence, it appears to be more logical to admit that the poison, which is known to have the power to induce the disease, has been carried in some undiscovered way, than to speculate on the possible existence of new causes, of which nothing can be demonstrated, and of the operation of which in the production of the disease no single instance can be adduced.

Vesicular diseases among cattle were evidently well known to the earliest writers on epizootics. Mills refers to a malady among cattle in Germany and Italy which was introduced from Hungary in 1711, and which was distinguished by some of the prominent features of the foot-and-mouth distemper of the present time. The tongue was inflamed and covered with blisters, and there was a constant discharge of saliva, which, being dropped on the grass, communicated the infection to sound cattle. A little later a similar disease existed in Moravia and also in France, and, according to Mr. Finlay Dunn, it extended to Great Britain about the middle of the eighteenth century. In 1810 a similar aphthous affection appeared in many parts of France. In 1834 it was prevalent in Hungary, Lower Austria, Bohemia, Saxony, and Prussia. In 1837 an aphthous disease occurred among cattle in the Vosges, and soon afterwards in Switzerland. The affection extended over France and Holland, and reached England in 1839.

Whether or not the disease which attacked cattle in this country in the middle of the eighteenth century was allied to or identical with foot-and-mouth distemper cannot be determined. The records of animal plagues are obscured in the earliest works by the use of terms which now have no definite meaning, as blain, murrain, or distemper; but there is no doubt whatever of the identity of the vesicular disease which attacked our cattle in 1839 with the present foot-and-mouth complaint; indeed, there is ample evidence of the continued existence of the affection in the United Kingdom from that time. Professor Simonds first saw foot-and-mouth disease among animals at Laleham, near Twickenham, in September 1839, and it appeared from his investigations that the malady was introduced on the farm at Laleham by some sucking calves which were bought in the Smithfield market. The first animal which was attacked at Laleham was a cow which suckled one of the affected calves. Further inquiry led to the discovery that the disease first appeared in the neighbourhood of Stratford, near London, whence it was conveyed to Smithfield, and having once obtained an entrance into the cattle-markets it may be easily imagined how rapidly it would spread throughout the country. Unrecognised at the time, and its nature unsuspected, it would not be likely to attract much attention until it had assumed alarming proportions. This soon happened.

The county of Norfolk was the next to suffer, then Essex, in consequence of the movement of cattle from the London market. Some Devon cattle at Langley Grange near Loddon in Norfolk were attacked in September 1839, about the time of the appearance of the disease at Laleham; and almost immediately afterwards, if not at the same moment, it was discovered in Scotland. Ireland certainly suffered from its invasion soon after it reached Great Britain.

In the census of Ireland for 1851, it is stated that in the year 1841 a disease, characterised by stiffness of limbs and blisters on the tongue, spread among sheep in county Clare, and affected cattle, sheep, pigs, and goats in all parts of Ireland.

Professor Ferguson, in a pamphlet which he published in 1842, refers to a pustular affection of the nose, mouth, and feet of cattle which appeared three years before that date, about the time it appeared in England. How foot-and-mouth disease was introduced into the United Kingdom has never been ascertained; but the evidence points to Holland or France as the centre from which the malady was communicated. It is true that foreign animals were not permitted to be landed on our shores between 1833, when the first prohibitory Order was passed, and 1842, when a relaxation was sanctioned, but it is quite probable, as Professor Simonds has suggested, that the disease may have been introduced by ships' stores; that is to say, animals carried on board for the use of the passengers and crew during the voyage. It constantly occurs that one or two pigs, and now and then a cow or two, and some few sheep remain on board on the arrival of the vessel in this country, and such animals are allowed to be landed and removed with the certificate of a veterinary inspector. A store animal might have contracted the affection when the vessel touched at a French or Dutch port, and on arriving in this country may have been released without suspicion, and possibly have found its way into the Smithfield market. Other explanations have been offered, such as the illegal importation of cattle, communication of infection by means of foreign hides, or by the clothes of persons who had been in contact with diseased foreign animals; but these suggestions are not so satisfactory as the one which refers the disease to the removal of a diseased or infected pig or cow from a homeward vessel.

Fairly stated, the evidence of the introduction of the disease from the Continent is vague, and the result arrived at is not capable of proof; but must rather be taken as an induction than as a conclusion. The facts are briefly these:—In 1839 foot-and-mouth disease prevailed in Germany, Holland, and France. In the same year it reached England, Ireland, and Scotland; countries which had previously been free from the disease, or at least had not suffered from it, or any disease resembling it, for a century. The fact that this immunity was enjoyed, notwithstanding the prevalence of the disease in various parts of Europe, at different times, is worthy of remark. No prohibition against the importation of foreign cattle existed before 1833, and it is a matter of history that foreign animals were imported up to that time, not probably in large number, but presumably to a far greater extent than during the years when importation was altogether forbidden.

After a few months of prevalence, foot-and-mouth disease became so widely spread, that the Royal Agricultural Society ordered an investigation into the origin of the disease and the best means of dealing with it.

Professor Sewell was the veterinary adviser of the Society at that time, and, under his direction, a circular was issued on April 8th, 1840, in which the disease is thus described:—

> In some animals it commences between the claws, and in others it appears to have begun in the mouth; in others a stiffness of the legs is first perceived, as if treading upon thorns and briars; then follows a discharge of saliva from the mouth, and a champing of the lips, accompanied with blisters on the tongue, palate, and lips; the blisters peel off; loss of appetite and general debility ensue.

After this account of the symptoms of the disease, written in terms which might be properly employed now without variation, certain directions are given as to treatment of the diseased animals.

Great stress is laid on good nursing; mild laxatives followed by tonics are recommended, with astringent lotion for the mouth;

poultices to the feet, and afterwards styptics or caustics, according to circumstances.

Perhaps this system of treatment, in the hands of Professor Sewell, might in some cases have proved beneficial; but in general practice, with such variations and additions as each practitioner felt inclined to employ, its results were entirely disastrous; and it must be admitted that the remarkable fatality which attended the progress of the disease in 1840-1 was in great degree due to the recklessness of the medical treatment employed. Another circular was issued by the Society in February, 1841, for the purpose of obtaining information in respect of the causes of the disease and the conditions which favour its spread. The farmers who were addressed responded to the inquiry by giving their ideas on the subject, as well as the results of their observation; and a report embodying the information thus gained was published in the Society's Journal for 1841, but no light was thrown on the introduction of the malady, or the means of preventing its spread.

The outbreak of 1839-40 was the most severe of any which has occurred in this kingdom. Cattle were not the only victims, but the disease attacked sheep, pigs, and poultry. Sheep suffered to a remarkable extent, the feet as is usual in these animals being most severely affected, and it is recorded that in 1841, after a market at Smithfield, it was not uncommon for the persons employed in sweeping the market-place to collect basketfuls of the hoofs of sheep and pigs, which had been cast off during the day. And it was certainly not unusual to see the hoofs fall off the feet of pigs while the animals were being lifted into carts to be carried away for slaughter. Sloughing of the hoof-horn may indeed be looked on as one of the results of foot-and-mouth disease; but it has never since happened to the extent that it occurred in 1841.

While the outbreak of 1839-40 was excessively severe, its duration was not prolonged beyond the period of two years. In 1842 the disease had considerably abated, and the cases which occurred presented a much milder type.

Another outbreak, or accession of disease, is recorded to have occurred in 1845. In that year Norfolk again suffered severely from extensive ravages of the malady, as it had done on its first introduction in 1839. The outbreak of 1845 will be remembered in Norfolk, owing to the circumstance of the disease being so rapid in its progress, that St. Faith's Fair was prohibited. The origin of the outbreak is not known.

The prohibition against the importation of foreign stock was removed in July, 1842; foreign animals were allowed to be landed, on payment of a duty varying from 1*s*. to 20*s*. per head.

No increase of disease was noticed during the three succeeding years, and there is no evidence to show whether foot-and-mouth distemper was directly imported in 1845, or extended from the centres which then existed in this country.

Again, the disease gradually declined. The duty on foreign stock was removed in March, 1846, and a great increase in the number of foreign animals imported immediately resulted, but no fresh outbreak of foot-and-mouth distemper occurred until 1849, when it is reported to have prevailed extensively among cattle and sheep in Scotland, and by 1852 it had extended over the whole of the country, appearing in many isolated places. A gradual decline appears to have taken place until 1861, when the number of attacks again rose considerably. The records of the progress of the affection during this time, and indeed at all times, are very meagre, the disease being too trifling a matter, it would seem, to occasion much excitement.

From 1861 the affection continued to prevail for several years. In 1862 it was detected among some Breton cattle in the Royal Agricultural Society's Showyard at Battersea, and it was undoubtedly the case that the distribution of the animals all over the country, at the conclusion of the show, caused the disease to be widely spread. Shortly after the Battersea exhibition of stock, foot-and-mouth disease existed in a malignant form among cattle and sheep at Harrow ; but, in this case, there is reason to believe that the disease was associated with blood poison, owing to the contamination of the land with sewage matter which was retained by the tenacious soil.

In 1863 an outbreak of foot-and-mouth complaint occurred among the cattle at the show of fat stock of the Smithfield Club. During that and the following year, however, the disease declined.

The first attempt to control the spread of foot-and-mouth disease by legislation was made in 1864, when a Bill was introduced by Mr. Bruce and Sir George Grey on February 19 to make further provision for the prevention of infectious diseases among cattle. Foot-and-mouth disease was included in the schedule as an infectious disease, but the opposition to the introduction of any restrictive measure in relation to that disease was so decided on the part of leading agriculturists and persons connected with the cattle trade, that it was struck out of the Bill as amended in Committee. The general allegations were that the proposed restrictions would hamper trade, and would not effectually get rid of the disease, while the loss which would be occasioned would be more serious than that inflicted by the malady when allowed to run unchecked.

In the spring of 1865 foot-and-mouth disease was again extensively prevalent. When cattle-plague appeared, foot-and-mouth disease was rife, and numerous opportunities occurred of comparing the morbid appearances of the two diseases, and tracing their progress in the same animal. So virulent was the attack in some instances, that the condition of the mouth resembled the state of that part in the worst forms of cattle-plague so closely as to attract special attention, and even in some instances to give rise to a suspicion of an outbreak of the plague.

Among the great outbreaks of foot-and-mouth disease, that of 1865 will always occupy a remarkable position, owing to the alleged influence of the cattle-plague restrictions in arresting the progress of the malady, and, according to some, completely eradicating it from the country.

It is undoubtedly true that foot-and-mouth disease declined in the latter part of 1866, and during the greater part of 1867 there were very few centres of infection; at least, little notice was taken of the disease, but it is entirely fallacious to assert that the malady ceased entirely until it was re-imported from abroad.

Cattle-plague restrictions, as the repressive measures are commonly termed, including stoppage of the movement of cattle all over the country, except by licence, and under strict regulations, between sunrise and sunset, holding of fairs and markets only by licence, declaration of infected places, with prohibition of movement of cattle out of such declared areas; and not least, the establishment of a sanitary cordon round the metropolis, were commenced on March 24, 1866, and were continued by successive Orders of Council, with slight modifications, until they were revoked by an Order of Council dated June 16, 1868.

At the time of the institution of these restrictions, the foot-and-mouth complaint had prevailed in a severe form for more than a year, and it continued to exist certainly for nearly another year while they were in operation.

No increase in the number of attacks took place in 1868; in fact, the disease during that year remained in such an ordinary condition of existence that little notice was taken of it. At the same time it is to be remarked that the cattle-plague restrictions ceased to operate in June, 1868, and cattle were moved with perfect freedom everywhere excepting the metropolis, round which the sanitary cordon was still retained.

General acceptance has been given to the statement that foot-and-mouth disease was arrested, if not exterminated, by the operation of the regulations which were directed to the extermination of cattle-plague; but it must be admitted that the grounds on which this conclusion is based are exceedingly slight. The bare fact that foot-and-mouth disease declined after two years of prevalence would have called for no remark if it had occurred, as in previous outbreaks it did occur, independently of any restrictions; but taken in connection with the existence of more stringent regulations in respect of the movement of cattle, the event was naturally, and without hesitation, ascribed to their influence; and there was something so completely satisfactory in the belief of the advantages which were presumed to have been gained by submission to annoying restrictions, that no one thought of casting a doubt on the popular faith, nor, indeed, was it worth while to inquire into the grounds of its acceptance, until it was vitiated by the gratuitous assertion that Great Britain was free from foot-and-mouth disease on the cessation of cattle-plague, and did not again suffer from it until the affection was introduced from abroad, a proposition quite opposed to the facts which have just been advanced. *Post hoc, propter hoc*, involves a principle which philosophy repudiates, nevertheless philosophers, as well as other people, constantly accept the principle as a basis of argument.

The spring of 1869 was marked by what may be termed the commencement of the last great outbreak, which has only recently ceased. Not only in this kingdom, but also on the continent, the disease spread with remarkable rapidity, most probably under the influence of those unknown laws which regulate the spread of epizootics. Diseased animals were landed on our coasts from nearly all the continental ports, and there can be no doubt that infected foreign animals which were moved into the country contributed to spread the disease, as the regulation for the slaughter of the whole cargo in the event of the discovery of foot-and-mouth disease did not then exist.

In August, 1869, foot-and-mouth disease was, for the first time in this country, included among infectious diseases by Act of Parliament; and it became a penal offence to move an animal affected with the disease on public roads or rivers, or to expose it in a fair or market. An Order of Council subsequently issued required the owner of such animal to give notice of the existence of disease, and the Inspectors or the Local Authorities were required to make returns of the number of cases within their districts. Notwithstanding this attempt to arrest the disease by legislation it continued to spread.

In December of that year an outbreak of foot-and-mouth disease among cattle at the Smithfield Show at Islington occasioned considerable inconvenience. Provisions had been made under the Order of Council which was necessary to enable the Club to hold the exhibition, for the removal out of the metropolis of the cattle exhibited if no outbreak of contagious disease occurred. On this occasion everything went on satisfactorily until the Show was over and a large portion of the stock had been removed.

On the Friday morning, the last day of the Show, all the cattle were separately examined without the detection of any case of disease; but on the following morning, at 10 o'clock, a Devon ox was found to be suffering from the incipient stage of the malady. The remaining cattle, about 45 in number, were detained until arrangements could be made for their slaughter in the metropolis. All the cattle were removed by licence between Monday and Tuesday, but before the Hall was cleared six other animals gave evidence of disease. There was nothing remarkable in the outbreak save the fact of the cattle remaining healthy in the Hall for eight days, while the ordinary period of incubation of the disease is three days. It could not be reasonably concluded that the Devon ox which was first attacked had been infected before entering the Show more than a week previously, and the only alternative presumption was that the infection had been introduced by persons who had entered the Show after attending to, or being in contact with, diseased cattle, either in the metropolitan market where the disease was prevalent, or in some of the London dairies.

In this year Ireland, which had been tolerably free from foot-and-mouth disease for some time, suffered from the introduction of diseased cattle which were sent from Bristol Market and exposed for sale in one of the Irish stock markets. From this centre it is alleged the disease spread very rapidly over the country.

In England the malady continued to extend, and a few local authorities applied for the establishment of more stringent rules. The applications were granted, and the movement of diseased animals, and of animals which had been herded with them, was prevented by Order of Council. This measure, however, was quickly revoked, in consequence of the almost universal opposition with which it was met.

During 1870 foot-and-mouth disease rather increased than abated its ravages. According to the returns many fresh outbreaks happened every week.

In December the disease again showed itself in the Smithfield Show. On the last day of the exhibition one of the cattle, a cross-bred ox, was found to be affected. In this case the animal gave evidence of ill health on the morning of the day, but the distinctive symptoms of foot-and-mouth disease were not developed until 4 o'clock in the afternoon. Accordingly the movement of the cattle out of the metropolis was interdicted to the consternation of owners and salesmen, who at once addressed the Government on the subject, and represented the serious loss which would be incurred if all the animals were slaughtered in the metropolis. After considerable discussion arrangements were made for the removal of the healthy cattle into the country for slaughter on the following conditions. Every animal so removed was to be examined by one of the Inspectors of the Veterinary Department, and certified to be free from evidence of infectious or contagious disease. Each animal was to be moved in charge of a person approved by the Veterinary Department, and the person selected was required to remain in charge of the animal until the slaughter took place, and then to certify the fact to the Department.

All expenses attending the carrying out of these conditions had to be defrayed by the owners or purchasers of the cattle. And notwithstanding the amount of trouble and expense involved, the conditions were accepted almost without exception by those who were entitled to take advantage of the concession.

The year 1871 was distinguished by the extensive prevalence of the disease all over the kingdom. Ireland is reported to have received diseased animals from us in May, and it is a matter of fact that during this year the complaint reached every one of the counties in Ireland.

Great Britain returned to the Veterinary Department more than 52,000 fresh outbreaks in the course of the year, and it may be taken as an undoubted fact that the return did not include more than a reasonable proportion of the cases which actually occurred. Foot-and-mouth disease again appeared at the fat stock exhibition of the Smithfield Club in December of this year; but owing to the action taken there was less inconvenience experienced by the exhibitors than was suffered by them on the former occasions which have been noticed.

Before the Show was held the Council of the Smithfield Club took an agricultural view of the subject, and succeeded in obtaining an Order of Council so worded, that only the diseased animals, if any, would be necessarily slaughtered in the metropolis. The usual arrangements in regard to inspection were made, and a shed was set apart for the reception of diseased animals, which was, unfortunately, well filled.

Almost the first animals which arrived came from the Birmingham Show and were found to be suffering from the disease. The diseased cattle were not allowed to enter the Show, but were placed in a shed provided for the emergency. This precaution, however, did not in any way protect the healthy cattle, which sometimes were carried in the same vans with the diseased, and it was, therefore, naturally expected that the affection would spread.

Early in the week of the Show many of the cattle began to show signs of illness, and by the end of the week more than 70 of them were suffering from foot-and-mouth disease, besides those (18 in number) which were excluded from the Show in the first instance, and handed over to the local authority.

In the beginning of 1872, the returns which had, since the passing of the Act, been required from the local authorities, were not longer demanded, and it is therefore impossible to make any satisfactory comparison between the condition of prevalence of the disease in 1871 and 1872. From various sources, however, information was obtained from time to time, and the evidence altogether leads to the conclusion that in the latter part of this year the decline of the disease began, although many fresh outbreaks occurred in the country.

On the continent there was no abatement of the progress of foot-and-mouth complaint. Cargoes of animals among which disease existed were constantly landed at our ports during the year, but owing to the rigorous adoption of the regulation which condemned the whole cargo to slaughter if one animal was affected with the disease, no extension of it occurred from this cause; in fact, while the affection was declining in many parts of England it was spreading with rapidity in Germany, including Schleswig and Holstein, and other parts of the continent. Towards the end of the year the decline of the malady became more marked, and it continued through the spring and summer of the present year, with occasional fresh outbreaks in different parts of the country.

The precautions taken by the Council of the Smithfield Club to prevent the entrance of diseased animals in 1872 were exceedingly stringent. Cattle which had been exhibited at any show within three months previously to the Smithfield Show were not allowed admission, and very precise rules were established relative to the manner of transit, cattle only being allowed to travel in horse boxes or private conveyances.

The means adopted were perfectly effectual; no diseased animals were detected at the entrance of the show-yard, and no outbreak occurred during the Show, although it is probable that some of the cattle were infected while in the Hall, as they showed symptoms of the disease immediately after their return home.

During the present year (1873) the decline of foot-and-mouth disease has steadily continued, and at this time (the month of August), when the disease would, according to the rule which has obtained for the last three years of its prevalence, have nearly reached its maximum, it is in a minimum condition in this country, and, so far as our information reaches, on the continent also. For some months past very few cases of the disease have been detected among the foreign animals landed at our ports. Ireland also is reported to be nearly free from the disease.

The history of foot-and-mouth disease might be considerably extended by reference to the records of its progress in various parts of Europe, Africa, America, and Australia. No contagious disease of animals is so widely spread, and certainly none is more readily communicated from diseased to healthy stock. In no European country has the disease been eradicated by legislative measures, although restrictions on the movement of cattle have always succeeded in keeping it in check. In Australia the adoption of severe measures immediately on the discovery of the disease effectually arrested its course, and the prohibition of imports of cattle from England has since kept it out of the country. Our position as an importing country forbids us to hope for the eradication of the distemper after more than thirty years' constant existence here, by the adoption of measures which would be effectual on its first appearance in a country; nor if we succeeded in completely eradicating the malady from the whole kingdom, could we expect to avoid its re-importation, unless we consented to hamper the foreign cattle trade by insisting on the slaughter at the place of landing of all foreign animals without exception—an extreme measure which is not likely to be adopted on account of a disease which is not fatal in its results, and one which people have learned to look upon as indigenous to this country. Experience of the last few years goes to show that even moderate legislation directed against this affection will not find any support from owners of cattle, or persons concerned in the cattle trade, and in the face of this experience it would be idle to attempt to carry out more severe measures, which to be effective must be permanent in their operation.

Much may be done by stock owners to prevent the spread of foot-and-mouth disease if they think the matter of sufficient importance to deserve a little trouble and attention. To this end certain suggestions will be offered under the head of Prevention.

Causes which contribute to the Spread of Foot-and-Mouth Disease.

Most prominent among the influences which regulate the extension of foot-and-mouth complaint and other contagious maladies, is the varying degree of susceptibility of the animal organism to be acted on by the specific poison. The history of animal plagues proves beyond question that under apparently similar conditions a disease will at one time appear in isolated positions, and confine its attack to few animals, while perhaps in the succeeding season its spread is rapid and extensive, and all the subjects within reach of the infection are indiscriminately included.

Foot-and-mouth disease is no exception to this rule; since its introduction into this kingdom in 1839 it has manifested itself at certain periods in the form of an epizootic, ravaging extensive tracts of country, and having exhausted its force on the susceptible animals within its reach, has declined until it reached a minimum. Sometimes the affection assumed the character of an enzootic, but in these instances there was always a reasonable explanation of the limited spread of the disease, in the circumstances of the locality; either the cattle population was small, or the district was out of the way of cattle traffic, and the affection having attacked the animals in the place, ceased for want of new material.

In reference to the direction which epizootic diseases take, there is a general belief that they always proceed westward, and there is some evidence in support of this view; but so far as foot-and-mouth disease, and indeed all other infectious maladies of stock are concerned, the rule has no existence in this kingdom. Railways radiate in all directions, and it may be assumed with safety, that from the centres of disease the virus will be conveyed wherever the lines of cattle traffic extend.

Granting the influence of susceptibility in modifying the progress of contagious diseases, the chief cause of their spread is the movement of diseased and infected animals in the ordinary course of trade; and very curiously this practically vital point in sanitary law has received the least attention, not from the legislature, but from the stock-owner.

If a critic wished to secure attention to his remarks, he would carefully avoid such a commonplace statement as that which refers the extension of disease to the movement of infected animals, and proceed to a discussion of the possibility of spontaneous origin, the prevalence of minute spores of fungi, atmospheric changes, and indirect conveyance of the poison by flies, birds, and the smaller quadrupeds, which, if not themselves liable to be attacked with the disease, may carry on their feet, or other parts of their bodies, the excreta from diseased animals. Full weight may be allowed for all the mischief done by the indirect conveyance of infection by men, animals, or substances which have been in contact with diseased beasts, or with the products of the disease; but still the fact remains, that the malady is kept in a state of activity mainly by means of the living creatures which are suffering from it. During the inquiries which have at different times been instituted in the country for the purpose of determining the causes of the extraordinary prevalence of foot-and-mouth disease in certain districts, the fact above stated has invariably been brought out very prominently. Difficulties have been met with in the endeavour to account for the introduction of the affection; frequently it has been impossible to define the actual date of the outbreak, and more often than otherwise it has been necessary to suggest several possible or probable channels of communication with distant centres of infection; but when the existence of a single case of the malady is admitted, it is always easy enough to account for the spread of the infection. No better illustration of the conditions under which foot-and-mouth disease spreads with excessive rapidity can be found than the one which was afforded by the county of Somerset, at the time when the malady prevailed there in the summer and autumn of 1870.

Before the inquiry was commenced, a general statement had been made and commonly accepted, that animals, principally Irish cattle, bought in Bristol market, introduced the affection into the county in the first instance, and constantly kept up the supply of infection. This statement was not unreasonable, and was therefore taken as a basis in the subsequent investigation. Very shortly, however, it appeared that Irish cattle from Bristol market were not solely, or even in the greatest part, responsible for the condition of the cattle in the county of Somerset, and in many instances they had nothing at all to do with the original outbreaks.

In the Frome district, the first outbreaks were traced to the introduction of pigs from Bristol and Salisbury markets into the market at Frome. Dealers are in the habit of moving pigs from one market to another. These animals are least likely to attract observation when suffering from foot-and-mouth disease, and, either in railway trucks, or market carts, may be moved all over the country with impunity. Numerous outbreaks of the disease were traced to exposure of diseased pigs in the markets, and, although the dealers were sometimes fined for the offence, it did not appear that the practice was checked. Probably the general immunity which was enjoyed by those who systematically evaded the law in this way sufficiently encouraged them to continue to incur a slight risk of detection and possible punishment. Considering the loss which dealers would have suffered if they had acted in strict accordance with the law, it is scarcely a matter for surprise that they ignored all the regulations, the observance of which would have seriously interfered with their trade.

In the Glastonbury district, where the disease prevailed to a serious extent, many outbreaks were traced to the introduction of infected cattle from Bristol market; but there were also other sources of infection to be taken into account. One particular instance of the movement of diseased cattle for a long distance without detection of the existence of disease, attracted my attention at the time. The cattle were purchased at Southampton and taken to Glastonbury, whence they were driven across the moors to the owner's premises. Foot-and-mouth disease was discovered among them the day after their arrival, and due notice was given to the authorities; but the facts which subsequently transpired proved that they must have been affected for some time previously, as they left a line of infection behind them; the disease appeared in nearly every place through which they had passed on their route.

In the Wells district foot-and-mouth disease was introduced repeatedly by cattle brought from Bristol, Chippenham, and Frome markets.

In the Bridgewater district disease was introduced originally from Bristol market. The first outbreak occurred at Huntspill, and from that point the affection extended to cattle which were grazing on the Pawlet Hams, where there were no means of isolating diseased animals or applying sanitary regulations to check the spread of infection. No mystery attached to the origin of the disease in any of the districts where it prevailed. There was no occasion to suggest possible means of communication of the virus through the medium of the atmosphere or other less direct channels. The fact was patent enough that diseased and infected cattle, sheep, and pigs, were regularly moved by road, rail, and boat, from various parts of the kingdom to fairs and markets. Seizure of diseased animals did not materially lessen the mischief done, and the more effective measure, the prevention of the movement of those which had been herded with them, could not be carried out without an entire stoppage of the cattle trade.

Irish animals were frequently landed at Bristol and other ports suffering from the disease, sent to the markets and distributed over the country, carrying the affection with them wherever they went; but home-bred stock also suffering from the disease were moved with equal freedom and at least to an equal extent, and no remedy could be effectively applied to the one class of animals without including the other. In short it was clear, during the time of the greatest prevalence of the disease, that nothing less than a general interruption to the movement of cattle all over the kingdom, would be sufficient even to control its progress.

Bristol market was for some reason specially selected for attack as the great centre of infection; but a careful investigation proved, that even in the county of Somerset, Bristol was by no means the only distributing centre. The markets at Southampton, Salisbury, and Frome, it was ascertained, had contributed their share of diseased and infected cattle and pigs. And it is certainly true that more attention was paid to the cleansing and disinfection of Bristol market than to any other market in the country. Under the direction of the Inspector, who had full powers to act, the place was well swept after each market. The ground was covered with quick-lime; and lime wash with carbolic acid was applied to the walls of the pens in which cattle had been placed. All the sweepings and manure from the market were removed to the farms in the occupation of the lessee, whose cattle did not suffer in consequence, as it appeared on inquiry that he had only had two outbreaks of disease on his two farms for several years; in each case the disease was introduced by cattle which he purchased in the market.

It must be obvious, that no amount of care in cleansing and disinfecting market places, or other places where cattle are kept, can in any degree prevent the extension of disease from the movement of diseased or infected animals. These cleansing processes, if properly carried out, may be presumed to prevent the extension of disease from the presence of active contagion left by diseased animals which previously occupied the lairs or other places. More than this cannot be expected.

Having discovered the sources of the infection, in the county of Somerset, there was no difficulty in explaining the rapid spread of the disease. The presence of a single diseased animal, for example, on the Pawlet Hams, could not fail to occasion the wide extension of the affection, and taking the vast grazing district round Glastonbury, practically an open plain, as the pastures are only separated from each other by dykes or slight fences, there are no sufficient barriers to the association of diseased and healthy animals, it is at once apparent that in such a position an infectious malady must spread. Isolation and disinfection are utterly impossible of application, and under such conditions the disease advances without any check, until all the susceptible animals are affected.

Exposure of diseased animals in fairs and markets has in very many instances caused the distribution of the disease over a wide extent of country; and, unfortunately, no amount of vigilance on the part of the Inspector of the market, or of energetic action on the part of the Local Authorities, can prevent the mischief. Diseased animals may be seized, and the owners fined for exposing them, but meanwhile the virus has done its work in the systems of many animals which were healthy on the day of the market, but which, in a few days' time, will certainly exhibit the disease. In Bristol market, owing to the unceasing vigilance of the Inspector and the determination of the authorities to carry out the law, nearly all the Irish dealers were fined in turn for exposing diseased cattle or pigs in the market; but however necessary this course might be for the purpose of deterring others from committing a like offence, it is doubtful if any sanitary gain resulted. The seizure of the diseased animals did not prevent the infection of others in the market, and the punishment inflicted on the dealers induced them to obtain the aid of a veterinary surgeon to inspect their stock on the morning of the market and select all which gave evidence of disease; these were, of course, kept on the premises or otherwise disposed of, and those which had been up to the market day herded with them, but were not then discoverably affected, were sent to the market and sold to carry the disease to all parts of the country. Owing to this arrangement it happened that for some months during the prevalence of the disease no diseased animals were to be found in Bristol market; the fact, however, of there being a considerable number of infected animals there was perfectly well known at the time, and was abundantly proved by the numerous outbreaks which occurred among the animals after they arrived at their destination.

Cleansing and disinfection of markets and lairs attached to them is far more easily suggested than carried into effect. Often it happens that the cost of the work would be almost ruinous owing to the extent of surface to be gone over. Not unfrequently the position of the market place, the streets in the town for instance, or a large field, renders any effective cleansing and disinfecting impracticable, but in such instances there is good reason to believe that the atmosphere does all that is necessary to be done before the next market. Some markets and lairs are conveniently arranged for the application of disinfectants, and such application should always be insisted on, at least on every occasion when diseased animals are exposed for sale. But after all, observation is in favour of the belief that little harm arises from the morbific matter which is left in an open market by one or two diseased animals on a market day. A few days' exposure to air and moisture will be sufficient to neutralize the poison; but undoubtedly, much injury is produced by turning animals out of a market into adjacent lairs to wait till the next market day, such places become, in times of prevalence of the disease, centres of infection which should be dealt with stringently, and regularly cleansed and disinfected under proper supervision.

Movement of diseased animals along public roads, or in any way, by land or water, is admitted to be a fruitful cause of the spread of the affection. The secretions and excretions, more particularly the saliva, which flows abundantly from the mouth of the diseased beasts, are certain to communicate the disease to cattle, sheep, and pigs which are moved along the same roads or are conveyed in the same trucks or vessels, immediately after the diseased animals have deposited the morbific matter.

Much of the injury done by transit of diseased cattle and other animals cannot be prevented by any care. It is impossible to disinfect roads, or even to ascertain at what points the virus has fallen. Pens at railway stations are in some respects equally difficult to deal with. Their chief use is for the reception of animals for the purpose of trucking, and on market days they are in constant requisition for many consecutive hours, as one lot of animals after another arrives at the station to be put into the trucks. A single diseased animal, which may occupy one of the pens for a short time in the early part of the day, may leave behind enough of the morbid matter to infect a considerable proportion of those which immediately follow, and until the work of the day is over it is impossible to disinfect the pens; indeed, when the hours of daylight barely suffice for the work of getting the animals off, the delay would disarrange the whole proceedings. The most that can be done, is to insist on the cleansing and disinfection of the pens as soon as possible after being used, and before they are again employed for the reception of animals in transit.

Vessels and trucks of any kind used for the conveyance of animals should certainly be cleansed and disinfected after the animals are removed and before other animals are placed in them. Strictly, this disinfection is only necessary after diseased animals have been conveyed, but it is impossible to prove that diseased animals have not been conveyed; the only safe course in such cases is to assume that they have been, and to proceed accordingly.

Introduction of infected animals from the continent may be placed among the causes which are concerned in the spread of foot-and-mouth disease in this kingdom, but the extent to which this cause has acted has been enormously over-rated. Occasionally infected animals may escape from the landing place to the interior of the country, but considering the short period of incubation of the disease, it is not likely that animals which are sent to us from infected herds or flocks abroad will pass through the time required for transit and the twelve hours' detention, very often prolonged to double the time, without showing some signs of disease sufficient to attract the attention of the inspector; and when the law requires that the whole of a mixed cargo must be slaughtered if any one animal of the cargo is affected with the disease, it cannot be reasonably contended that the regulations for the protection of home-bred stock are in this particular wanting in strictness, or that foreign imports are likely to add seriously to the causes which contribute to the spread of foot-and mouth complaint in this kingdom.

It has been often suggested that the hardships to which animals are subjected in transit have much to do with the origin and progress of foot-and-mouth complaint. The existence of hardship is undoubted ; the influence of such sufferings on the animal's condition cannot be questioned, and it may be admitted that, owing to the privations which are endured, the animal's system may be rendered more susceptible to the action of a specific *contagium*, as it certainly is to the attacks of ordinary diseases ; but beyond this nothing can be allowed. No amount of neglect or privation suffices to establish a contagious disease in the system unless the *contagium* is in some way introduced.

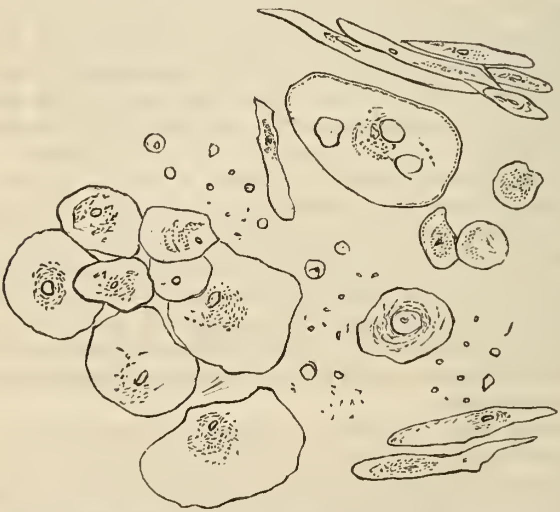
General characters of the Foot-and-Mouth Distemper in different Animals.

Of the various terms which are used to indicate this disease perhaps epizootic aphtha or eczema is the best. The expression foot-and-mouth disease conveys the erroneous idea that the affection always occurs in the mouth and feet, whereas other parts of the body are commonly attacked, and one of the parts referred to in the popular title may be entirely free. Essentially the disease consists in general irritation of the tegumentary and mucous structures, with febrile disturbance indicated by an increase of temperature. Introduction of the *contagium* into the system of a healthy animal is the only known cause of the disease.

After the poison enters the blood a period of two to four days elapses before the malady declares itself. This period is termed the incubative stage, which in exceptional cases is prolonged to a week. The first sign of infection having taken place is the rise of internal temperature three or four degrees ; in different cases the thermometer will indicate in cattle 104° to 105°, and in sheep 104° to 107°. Shortly following the rise of internal heat the well-known signs of the affection present themselves in quick succession.

Referring first to cattle, a marked symptom, which is not always present, is the peculiar smacking or sucking noise which the animal makes with its mouth ; discharge of saliva may often be noticed early in the disease, but this symptom by itself is not sufficient, as it is commonly present when animals have been long kept without water. A characteristic sign of disease in the feet is afforded by a peculiar movement of the affected limb, resembling an attempt to kick something off the foot ; this inclination is most marked when the hind feet are attacked. As the disease advances the animal stands in an uneasy position, often shuffling its feet and moving with difficulty; blisters appear between the claws and on the posterior part of the feet immediately above the hoofs, on the udder of milch cows, inside the lips, and on the tongue and palate. According to the severity of the attack will be the extent of these lesions; in mild cases only the mouth may be affected, and that to a slight extent, or the feet may be attacked alone. Very seldom are the vesicles developed to an equal extent in all the positions mentioned, but in all cases there is a tendency to the separation of the epithelial and epidermoid covering of the mucous membrane and skin; and it has been observed that the surface of the integument is desquamated in the form of dried scales for some time after recovery. Sometimes a quantity of yellow curdy exudation is formed at the posterior part of the tongue and on the palate somewhat resembling the exudation in cattle-plague. A very remarkable specimen of this kind was taken from an Irish heifer which died of foot-and-mouth disease at Thirsk in 1867. A microscopic examination of this deposit proved it to be simple epithelial matter, as shown in the illustration No. 1.

No. 1.



Microscopic appearance of a mass of curdy exudation from the posterior part of the tongue of an Irish heifer which died of virulent foot-and-mouth disease. Magnified 400 diameters.

Soon after their appearance the vesicles become ruptured, and the contents, a clear limpid fluid, containing few organic molecules, escape. Under favourable circumstances the healing process advances rapidly, the abraded surface is covered with a yellowish mass of exudation, which is ultimately condensed to form the epithelial covering. This yellow mass has been examined by the microscope, and found to consist of epithelial cells, which are represented in the next figure.

No. 2.

Microscopic appearance of yellow mass on the surface of a healing abrasion, after the rupture of a vesicle. Magnified 400 diameters.

When the disease is fully developed, all the secretions contain morbid elements, but, rather curiously, the saliva, which is the fluid most capable of conveying the disease, shows the least evidence of change; when obtained as free as possible from the mucus secreted by the glands of the membrane lining the cavity of the mouth, it is quite pellucid, and contains minute bodies, which move with rapidity, these are sometimes found in considerable quantities, and in many specimens bacteria and vibriones are also detected, similar in form and character to those which are depicted in the illustration No. 3, page 459, as they occur in the milk of diseased animals.

These peculiar bodies (bacteria and vibriones) are developed in fluids which contain a small quantity of animal matter, and they may therefore be taken as an evidence of decomposition. The fact of their existence in the blood and secretions of a living animal is always significant, but the discovery of them sometimes after the fluids have been separated from the living body is a matter of no moment.

Bacteria and vibriones have been detected in the limpid fluid of the vesicles with small masses of living germinal matter, and in the discharge from the eyes minute moving bodies have also been seen.

Microscopic examination of the blood reveals the presence of organic bodies which are always associated with a diseased condition of the fluid. First, the red blood-discs, on which the colour of the blood depends, are covered with minute projecting points, instead of being circular in form and smooth on the surface. There is also an excess of the colourless corpuscles, and there are also small spheroidal and elliptical bodies, which move rapidly in all directions, and sometimes very numerous bacteria and vibriones are found in large numbers in the advanced stage of the disease; their presence in large numbers is indicative of the malignant form of the affection, in which the condition is rather that of blood-poisoning than simple foot-and-mouth complaint.

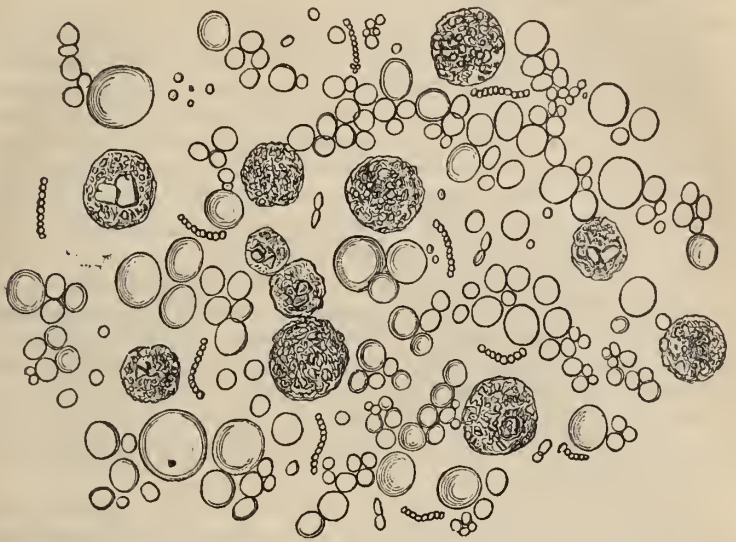
Milk taken from cows affected with the disease presents appearances which are very characteristic, but which vary much according to the stage of the disease. Most of the specimens examined had a low specific gravity, 1024, although in some instances when the quantity which was yielded was very small the normal specific gravity, 1032, was reached, and now and then exceeded, but in these instances the fluid was abnormal in character, being charged with large exudation cells, and, what is more significant, bacteria and vibriones were abundantly present.

The drawing which is represented in the next illustration was taken from a specimen of milk obtained from a cow which had suffered from the disease for ten days, and it by no means exaggerates the proportion of diseased elements in the milk.

In cases where the udder is seriously affected, the secretion of milk is almost arrested, and the little fluid which is obtained is highly charged with inflammatory products. Nearly all the specimens of milk obtained from cows affected with foot-and-mouth disease, however, contained more or less of the abnormal elements represented in the drawing, and in some the pus-like cells remained for several weeks after the animals had quite recovered.

Boiling the milk from diseased cows has considerable effect in retarding its decomposition, but it does not arrest the move-ments of the minute bodies which are so constantly present. Of the deleterious effects of the milk of diseased cows upon the

No. 3.



Microscopic appearance of milk in the advanced stage of foot-and-mouth disease, showing, besides the smooth circular milk corpuscles, large dark granular cells, many chain-like bodies (vibriones) and moving bodies composed of two elliptical links (bacteria). Magnified 400 diameters.

systems of other animals no doubt can be entertained. Sucking calves have been frequently poisoned by it even before the cow gave evidence of the disease, which then existed in the incubative stage. Pigs have been repeatedly infected by the milk when given to them warm from the cow, but the injurious qualities seem to be modified by boiling the fluid or keeping it for some time before it is used. Undoubtedly the safest course is to destroy it; but, if this is not done, it should not be given to pigs or other animals until it has been well boiled, and then allowed to get cold. As to the use of the milk for human consumption, it is sufficient to say that no one who had seen the fluid under the microscope would patiently contemplate the possibility of its being employed for the food of man, putting out of the question any risk of the disease being communicated to human beings by such means.

In its uncomplicated form foot-and-mouth disease ends in restoration of a healthy condition of the affected parts, and of the system generally, in a week or ten days; but various circumstances tend to retard its favourable course: unsanitary influences, existence of other diseases, debility, bad treatment, all have the effect of retarding the expulsion of the poison, and leading to a diseased state of the blood and the fluids derived from it.

Animals under these circumstances become emaciated, the abrasions of the buccal membrane advance to the condition of ulcers, the hoofs become loosened by exudation from the vascular membrane of the internal foot, abscess forms in the areolar membrane under the skin; skin wounds caused by the animal lying down much assume an unhealthy character, and large portions of the tissue are sloughed away, and the beast ultimately succumbs to a state which may correctly be termed putrid, otherwise it is destroyed as useless owing to the hopeless condition of the feet, and the general prostration.

Foot-and-mouth disease is sometimes complicated with more malignant diseases; as splenic apoplexy, apoplectic congestion of lungs, and other forms of blood disease; the fatality which attends these complications cannot properly be referred to the foot-and-mouth complaint, as the maladies themselves are exceedingly fatal, and it is probable that their virulent nature is not materially modified by the existence of the milder affection in conjunction with them.

An attack of foot-and-mouth disease does not protect the animal from any other disease, but it has usually been held that a recovered animal was safe from a return of the same affection; and there is evidence that a certain amount of protection is afforded against a second attack, although the system is not rendered absolutely secure for any length of time.

Instances of animals being affected with foot-and-mouth complaint twice in the space of a few months were of occasional occurrence in the early periods of the disease, and a third attack was not unknown. Recently, second and third attacks at short intervals among cattle have been more numerous, or at least more have been recorded; whether the cases have really been more frequent than in former years, or our attention has been more closely attracted to them, is not quite clear. Veterinary authorities in Switzerland however state, quite as a matter of course, that the susceptibility of the animal's system to the action of the virus is not only not exhausted, but is in no way lessened or otherwise modified by an attack of the disease.

Our experience in this country justifies the statement, that under ordinary circumstances, animals which have recovered from foot-and-mouth disease are not liable to the affection again, at a period so early as to excite attention; but it is also true that during the prevalence of the affection in an epizootic form, the liability to infection is indefinitely increased, and at the same time the amount of active *contagium* is also increased. In other terms, there are in the surrounding circumstances during the times of what are commonly called great outbreaks, greater powers of action, and in the animal system a greater susceptibility to be acted on; this susceptibility, which in ordinary seasons is exhausted by one attack, under the new conditions survives two or three accessions of disease. The practical conclusion from these facts is, that the farmer should never consider his cattle secure, but always maintain on his farm the sanitary regulations which will be hereafter referred to.

Sheep are liable to attacks of the foot-and-mouth complaint of cattle, but they most frequently suffer from it in a modified form. The mouth in most instances does not present the indications of disease which are seen in cattle, but the feet are almost without exception affected in a characteristic manner. Much discussion has arisen out of the circumstance that the vesicular epizootic of cattle is often confined to the feet of sheep, and frequent attempts have been made to prove that the disease in sheep is the common foot-rot, and not the epizootic affection which is seen in cattle. It would be impossible by any length of argument to convince a large class of practical men whose minds are made up on this point, of the fact that a scientific pathologist would have no difficulty in deciding at once, as to whether a sheep were affected with the aphthous disease, or some common form of foot affection; nevertheless no problem in pathology is more easily solved.

Of the several quite distinct local diseases of the foot of the sheep, none is distinguished by the presence of a blister or vesicle in any part of the foot, while in the foot-and-mouth disease there are always vesicles present, or distinct evidence of their previous existence, and there is also a general absence of that condition of hoof which is usual in foot-rot. In exceptional cases the hoofs are elongated, much broken, and sometimes ragged and rotten; but this condition has nothing to do with the aphthous disease, which is indicated by the presence of vesicles between the claws, in the posterior part of the foot immediately above the hoof, and sometimes exactly on the portion of skin between the digits which covers the transverse ligament connecting the two sides of the foot together, and which is rendered tense, and therefore distinct when the digits are pulled apart. When the posterior part of the hoof is separated from the secreting membrane, as it often is in foot-and-mouth disease, the vascular surface is seen to be congested, but there are no signs of the so-called fungoid growths which distinguish foot-rot. In short no two diseases can be more distinct from each other in the local appearances; but independently of the evidence afforded by the diseased parts, there is in cases of foot-and-mouth disease clear evidence of febrile action in the system. The animal's appetite may not be much affected, nor is it necessary that the demeanour should be suggestive of much suffering, but the application of the thermometer will show a rise of internal temperature when the animal is suffering from the aphthous affection. Making allowances for the variation of the temperature in sheep, which in health will range from 101° to 104°, the increase is quite marked, as the temperature in the diseased sheep will range from 104° to 107°. It will not, however, in the majority of cases, be necessary to use the thermometer to decide the question of the nature of the disease, as the local evidence will be sufficient.

Vesicles in the mouth of the sheep, although not so generally present as in cattle, are very commonly found when they are looked for, but as the idea has long been prevalent that sheep are not affected in the mouth, it naturally has happened that the part has escaped notice, and besides, the lesion is not so prominent as in the mouths of cattle, and, therefore, not so readily recognised by the unpractised eye. In lambs of a few weeks old vesicles not larger than a hemp seed have been detected on the tongue. Abrasions on the lips and palate are frequently seen in sheep identical in character with those which are observed in cattle; and altogether the evidence of the identity of the disease in cattle and sheep is perfectly conclusive, even irrespective of the admitted fact that the affection is intercommunicable in the two classes of animals.

Goats and deer are liable to foot-and-mouth complaint, but in reference to these animals the circumstances are such as render any minute observation very difficult. Goats are very little used in this country, and deer running wild cannot be critically examined; hence no specialities have been recorded in respect of the disease in them.

Pigs undoubtedly suffer extremely from aphthous disease, and in many localities it assumes among them a decidedly malignant form. Vesicles appear on the outside of the snout and along the edge of the upper lip; on the udder in sows, and almost invariably on the feet; the hoofs are constantly separated from the internal foot and fall off. The sufferings caused by the disease and its result often produce fatal prostration; so often, indeed, that the statement respecting foot-and-mouth disease being a benign affection does not apply to its existence among pigs.

Other animals than those mentioned as being subject to the affection in this country, are included by continental veterinary surgeons among susceptible subjects. Horses, dogs, hares, rabbits, and birds, are said to be attacked frequently, and to be capable of conveying the disease to farm stock. We have no evidence of a reliable kind in proof of the susceptibility of these animals to foot-and-mouth disease in this kingdom.

Horses and dogs, and probably other animals, are sometimes the subjects of febrile diseases in which abrasions of the buccal membrane occur; and lesions not unlike those of foot-and-mouth disease have been seen in horses in consequence of irritation produced by vegetable hairs; but the true aphthous disease has not been seen in this country, nor has it been found possible to produce it in horses, dogs, and rabbits; and among our birds only common fowls are known to have been attacked.

Losses on account of foot-and-mouth disease may be classified under various heads according to the circumstances in which the diseased animals are placed. Store cattle suffer least; under proper treatment a fatal result is very rare, and the loss of condition is not sufficient to retard the animal's growth to any serious extent. Fattening cattle are deteriorated in value to the amount of two to five pounds per head, according to various estimates; milch cows experience a loss or considerable decrease of milk, but the most serious losses are those among valuable breeding stock, including death of young animals from sucking the diseased milk, and the frequent occurrence of abortion among cows and ewes. The subject, however, of losses sustained has been amply discussed in the agricultural press, and it is not necessary to reiterate statements which are perfectly familiar to stock-owners, and of the truth of which they are capable of judging from actual experience.

Treatment of Foot-and-Mouth Disease.

The course which has been pursued by the veterinary profession, in reference to the medical treatment of contagious diseases of stock, supplies a positive contradiction to that most remarkable maxim, "Honesty is the best policy." The true policy of the veterinary surgeon is to adopt the practice of the physician, and attempt to cure disease, instead of to get rid of it, by the expeditious method of killing the patient. Veterinary surgeons might have gained the credit of curing all the animals which recovered from disease, instead of incurring the charge which they have themselves invited, of being incapable of dealing with maladies which are no more malignant than those which the practitioner of human medicine successfully attacks. Cholera, typhus, and small-pox are, it is alleged, as deadly as any form of cattle-plague, and yet no physician thinks of the stamping-out system in reference to them; on the contrary, all the experience of the past, and all the modern resources of science, are brought forward for their amelioration; while, in respect of the treatment of animal plagues, veterinary science pleads incapacity, and recommends the poleaxe.

Human plagues are in fact as incurable as cattle plagues, but the human doctor never deems it his duty to force his convictions of this truth on mankind, nor indeed to utter them at all, save in hesitant whisperings in the select circles of his scientific associates; hence, while the two divisions of medicine are on a par in regard to the effects which they can produce on the progress of epidemic and epizootic diseases, the practitioners of the two systems have become widely separated by the acceptance on each side of entirely opposite principles; one rejoicing in the belief that there is hope always while there is life, the others gloomily accepting the proposition that there is no hope but in death.

Whether or not veterinary surgeons were morally bound to publish their incapacity to cure, and in the interests of the country to recommend killing, is a point for the moral philosopher to determine; there can be no question of the error of policy thus committed, and the censure which the profession has incurred is a just reward for the deliberate abandonment of its true position.

In the true sense of the word all diseases are susceptible of cure, that is, of careful attention; but according to the usual acceptation of the term, only those maladies which can be arrested in their course—cut short, in fact, before they attain their full development—can be called curable. To use a familiar subject by way of illustration,—small-pox is by most persons considered to be a curable disease; its fatal character is admitted; nevertheless, various plans of treatment are tried with more or less success, that is to say with more or less disturbance of the average of fatality. Formerly, hot rooms and spare diet were deemed necessary to the cure; now, plenty of cool, pure air and nutritious food are deemed essential, and under the improved system of treatment, in which medicine plays a secondary part, the recoveries are far more numerous than they were under the old method. Still the affection passes through its various stages of incubation, invasion, vesication, pustulation, and desiccation, as though no medical interference were attempted. The disease is not arrested; on the contrary, the greatest care is given to facilitate its development, on the clear understanding that the interruption of the external expression of the disease in the form of a specific eruption, means retention of the poison, and deadly injury to the organism.

A distinction is to be drawn between the cure of a disease by the employment of an actually antagonistic agency, and the recovery of the patient under the careful attention of the physician who has watched, and in some degree guided, the malady through its stages without attempting to retard or modify its development.

Some ten years ago a veritable cure for small-pox was publicly announced, and there was no mistake as to the meaning of the terms employed. The North American plant *Sarracenia purpurea* was said to arrest the development of the pustules by destroying the poison of the disease in the system. This would have been true curative action, positive destruction of the morbid material, and the arrest of the abnormal process ; further inquiry, however, proved that the plant did not possess the power ascribed to it, and the disease remains, in the present state of our knowledge, incurable, that is to say, not susceptible of arrestation by the action of medicine. The most that the physician hopes to effect is to get the disease favourably through its various stages, and to support the system under the exhausting influence of the virus.

In exactly the same sense that small-pox of man is incurable, so is the foot-and-mouth complaint of cattle, a disease much less virulent in character, insusceptible to the action of medicines. A cure for this disease should be capable of arresting the course of the fever and preventing the formation of vesicles ; should, in fact, cut short the morbid process ; so that an animal which had been exposed to the infection, and gave indications of being the subject of the incipient disease by a rise of internal temperature, should be restored to health by the use of the medicine, without the manifestation of any further symptoms. No such curative agent as this has yet been discovered, and all the special modes of treatment which have been at different times advocated on the plea of their curative powers, may be safely relegated to the regions of quackery.

Curative means, in the extended sense of the word, may be successfully applied to foot-and-mouth complaint as to all other diseases ; that is to say, the sick animal may be taken care of, the symptoms may be sedulously watched, complications may be dealt with as they arise ; strict obedience to sanitary laws may be enjoined, and all hygienic appliances may be brought to bear with corresponding benefit to the patient ; but the conscientious practitioner, while he developes all the resources of his art, knows and admits that the means which he employs are palliative and not antagonistic to the morbid processes which he seeks to assist rather than to obstruct. The problem which he has to solve is how to assist in the elimination of a poison, and at the same time to support the vitality of the system, a widely different thing from neutralising the poison or preventing its formation.

The first thing which the therapeutist is called upon to determine is the precise nature of the disease which he is required to treat: without this knowledge his proceeding must be of the empirical order. When dealing with foot-and-mouth complaint, he has to remember that the affection belongs to the class exanthemata, or eruptive diseases, and that consequently a characteristic development of pimples, vesicles, or pustules, is part of the natural course of the disease through its various stages. Small-pox is distinguished by the successive appearance of the three kinds of eruption referred to; foot-and-mouth complaint is marked by one kind, the vesicular. The virus of the affection acts rapidly; symptoms of fever are manifested soon after the introduction of the poison into the system; the internal temperature rises three or four degrees; the secretion of milk in milch cows is diminished; and experience proves that some of the poison is excreted in this way very early in the disease.

Vesicles, or blisters as they would be called in popular language, begin to appear in from thirty-six to forty-eight hours after infection, as a rule, on the tongue, inside the lips, and often on the skin, especially of the hind legs, immediately above the hoofs, at the heels, and frequently at the junction of the digits.

General irritation exists all over the mucous and tegumental surface, and the epithelium is so far loosened that it may be removed by slight friction. The tendency to desquamation of the epithelial tissue is always most marked in the mucous membrane lining the cavity of the mouth, and in the modified integument which is reflected over the terminal portions of the extremities. The first result is unimportant; but the separation of the hoof from its secreting membrane is, under all circumstances, particularly in cattle, a very serious, and not uncommonly fatal, consequence of the disease, and should be, as far as possible, guarded against.

In a few days the poison of the disease, which, in the act of elimination from the system, leads to the development of the effects referred to, is, in favourable cases, completely expelled, the fever subsides, the loosened epithelium is rapidly replaced by new deposits of normal tissue, and the animal becomes convalescent, suffering only from the exhaustion which is proportioned to the severity of the attack, but from which recovery is very rapid, under a liberal system of dietetics. From the date of the eruption to the time of convalescence, in the favourable form of the disease, an average period of ten days will be occupied; and no medicine which has yet been tried possesses the power to shorten this period, or to arrest the course of the malady. Treatment, therefore, in this type of the disease should be tentative, rather than actively corrective. The duty of the veterinary surgeon is to preserve the normal action of the excreting organs without unduly exciting them, to guard against the tendency to desquamation of epithelial tissue, particularly in respect of the feet, and to afford all the support to the system which is necessary to counteract the depressing action of the poison.

These indications are fulfilled by the employment of salines, which are best given in the water which the animal drinks, as injury to the mouth by the violent use of the drenching horn is thereby avoided.

Chlorate of potash, sulphate of soda, and hyposulphite of soda, are the agents which are most effective and most easily administered. Sulphate of soda is useful when it is desirable to obtain a laxative action on the bowels. Four ounces of this salt may be dissolved in half a bucket of water, and placed in the animal's reach. The dose may be repeated as soon as the first quantity of fluid has been taken, and again, if necessary, in twelve hours, until the dejections are in a satisfactory state. Chlorate of potash is valuable when the mouth is much affected; the agent passes readily into the blood, and possesses, in addition to its febrifuge properties, considerable power in rectifying morbid changes in the circulating fluid. An ounce of the agent may be given in the drinking-water once or twice a day, according to the state of the animal.

Hyposulphite of soda, like the chlorate of potash, has a decidedly antiseptic property, and arrests putrefactive fermentation, therefore it is effective in blood-diseases; it is tasteless, cheap, and easily obtained, and, in any quantities that are likely to be administered, perfectly harmless. These advantages entitle the drug to a much higher position in veterinary medicine than it has yet attained.

Hyposulphite of soda may be dissolved in the drinking-water in such proportion that the animal may take about four ounces daily for a few days, after which the dose should be reduced to one-half the amount.

Sheep, which do not drink much when at grass, will take the medicine when it is mixed with tempting food, as bruised oats with a little malt; the dose may be calculated at one-fourth the quantity for an ox. In case of cattle refusing to drink the medicated water, the same plan of mixing the medicine with the food may be tried; but if both food and water are objected to when thus medicated, it will be in most cases much better to leave the animals without medicine than to administer it forcibly, unless complications, which require special treatment, should occur. Separation of the hoofs from the secreting membrane will be in a great degree prevented by early attention to the feet, and the necessity for this special care will be apparent when it is remembered that the majority of the fatal cases of this disease are those in which the feet are chiefly involved in the destructive changes. When vesicles appear between the digits, or on the posterior part of the foot immediately above the hoof, it may be concluded that separation is likely to commence at both those points. The thin layer of horny matter which in the ox connects the two horny digits together may be disconnected from the subjacent tissue by exudation of serous fluid; and at the same time the horn at the posterior part, which is also thin at its commencement, may become in like manner separated from the membrane which secretes it. In this condition of parts every movement of the animal tends to assist the process of disconnection. When in the act of advancing the animal presses on the toe of the hoof, and the forward movement tends to raise the internal foot out of the horny covering, just as the forward step of a man with slippers on which are down at the heels lifts the foot nearly out of the loosely attached slipper. When the boot is firmly laced to the foot this tendency to lifting of the heel is not felt; but the foot and the external covering, which well represents the hoof, move together as one piece. When disconnection, however, occurs at the posterior part of the hoof even to a very slight extent, movement must necessarily assist its progress.

Cattle are the more liable to loss of hoof, when suffering from foot-and-mouth disease, if the hoofs are overgrown and much elongated at the toe. The leverage thus obtained is detrimental to the structure even of the healthy foot, and becomes still more injurious when the connection between the hoof and its secreting membrane is loosened owing to exudation from the vascular surface. The feet of cattle and sheep should be carefully trimmed when necessary, even before they are attacked by the disease if possible; but in any case excessive growth of horn should be removed by saw and rasp to save the animal from the injuries which are likely to occur if those parts are allowed to remain in this distorted state during the progress of the disease.

Complete rest at the early stage of the disease, when the feet are attacked, is therefore quite an essential part of the curative treatment. Animals which are kept in houses will naturally be exempt from the danger of injuring their feet by moving about, and those which are at pasture, either sheep or cattle, may be temporarily kept from moving about by the use of rails and hurdles to form an enclosure, where there are no convenient sheds in which they may be sheltered.

A dry floor with plenty of clean litter cannot be dispensed with, and the feet must be kept perfectly clean; all foreign substances which have accumulated between the digits must be removed, and the feet afterwards well syringed with an antiseptic or styptic solution. Four ounces of common nitre to a gallon of water will make a lotion which is very effective in the early stage of the disease; it may be used with a common syringe two or three times a day. Large vesicles between the digits or on the heels, if they are full of fluid, should be punctured in order to prevent the mechanical effects of fluid pressure, and any portions of the separated horny tissue which becomes blackened and rotten should be cut away with scissors, as they will increase the irritation and prevent the secretion of new horny structure of proper density.

Powerful astringent applications, which will arrest the discharge altogether, are not proper for the feet; indeed, their use is likely to cause active inflammation of the parts, which otherwise would only suffer from irritation; but if the nitrate of potash does not sufficiently control the exudation from the diseased surface, a solution of chloride of zinc, one part of Sir W. Burnett's fluid to fifty parts of water, may be used instead.

Carbolic acid in solution, of the same strength as the zinc lotion, is also a very good application.

Alum-water, made by dissolving an ounce of alum in a quart of water, is more decidedly styptic than either of the other lotions, and may be resorted to when they are not sufficiently potent to arrest the exudation from the diseased membrane.

The mildest remedy—the nitre lotion—should always be used in the first instance, and during the continuance of fever. The more active solutions may be employed when the thermometer indicates a return to the natural temperature, not exceeding 102 degrees.

After all the local inflammation or irritation has subsided, and the exposed membrane of the internal foot becomes covered with healthy horn tissue, a coating of common tar will be useful as a protection to the newly-developed structure, but, while active disease is present, this material, so commonly used, often mixed with caustic agents, adds to the local excitement, and embarrasses the surgeon by obscuring his view of the diseased parts.

When the udder is implicated in the disease, as it often is, even in the mild form of it, great attention must be paid to the part, especially when the animals are in milk. The most simple manifestation of the affection in this region is the development of a few vesicles on various parts of the integument covering the gland, frequently on the teats, even on the apex round the opening of the canal.

Swelling with redness and heat may affect the whole gland, or be confined to one quarter, and in many cases one or two quarters are painful, and very hard to the touch.

Local treatment of the udder will be necessary, in addition to the other means which have already been recommended.

When swelling and pain are present, fomentations must be frequently employed for some days until the active disease has subsided. All astringent and styptic applications at this time are to be avoided, as likely to increase the excitement.

If no active irritation present itself, or otherwise if the inflammatory signs have been subdued by soothing treatment, mild astringent applications are useful. Thus, when the vesicles first appear on the teats or other parts of the udder, the application of the alum-wash, composed of one ounce of alum to a quart of water, will lessen the tendency which always exists to the separation of the cuticular tissues from the vascular membrane beneath, and at the same time diminish the irritation. Some benefit will also be expected to arise from the antiseptic properties of the solution. Carbolic acid has been used for this purpose, but dairymen object to it on the ground that it imparts a smell and flavour to the milk—a property which is, in reality, on sanitary grounds, altogether in favour of its use, as the fluid would thereby be prevented from coming into consumption.

One other point must be sedulously attended to in all cases where the udder is affected, no matter to what extent; the animal must be regularly and effectually milked; retention of this fluid in the gland is certain to add very seriously to the amount of mischief which is going on, and there is good reason to apprehend that much harm is constantly done by neglecting this precaution. Owing to the tenderness of the udder the cow naturally resists the attempt to remove the milk, and the attendant, under the circumstances, is not disinclined to escape a troublesome work, or, at best, to perform it so imperfectly, that it might as well have been left undone. It cannot be expected that the owner of the sick animals will be able to superintend all the important details of treatment on which success depends; and it is usually the case that any ill consequences, which are due to early neglect of simple remedies, are attributed to the virulence of the disease.

Separation of the epithelial tissues of the mouth and tongue in cases of eczema is not of so much importance as separation of the horn tissue, and therefore need not be so carefully guarded against. When the affection exists in the mitigated form which it usually assumes, the mouth requires no attention, and in the worst cases nothing more powerful than a solution of tannic acid, in the proportion of one ounce to a gallon of water, will be required. This solution may be used as a lotion twice a day, when the loss of epithelium is considerable, and the soreness of the mouth consequently extreme. About half a pint of the lotion should be gently poured into the mouth, and then, after the head has been for a moment slightly elevated, to cause the fluid to run to the back of the mouth, it may be permitted to flow out again. Should the whole quantity, however, be inadvertently swallowed, no harm will arise.

Tannic acid coagulates the albuminous material of the exudation, and thus furnishes a protective covering of some tenacity, while it lessens irritation by causing the minute vessels which are charged with blood to contract, thus lessening the pressure on the nerve-fibres.

The third indication—that is, the support of the system under the debilitating effects of the disease—as to be carried out principally by careful attention to the diet. When the mouth is sore the animal is disinclined to use the tongue or lips to collect its food, therefore it is necessary to perform this preparatory process for it. Cattle at pasture require that the grass be cut and placed in little hillocks near them. Roots must be sliced into long thin pieces, which may be grasped without difficulty between the lips. Hay will usually be taken readily; portions of oil-cake, if introduced into the side of the mouth by the fingers, and placed within reach of the back teeth, will be masticated freely. Pulped roots, and mashes containing a fair proportion of meal, may also be offered by way of varying the diet. Oil-cake, softened and mixed with water to form a gruel, will be of great value when an animal's mouth is so sore that it is only capable of sucking in such bland and liquid food. Tonic medicine will not be necessary in ordinary cases, careful nursing will be sufficient; but it must be remembered that, in the absence of attention to the diet, the sick animal's chances of recovery are reduced to a minimum.

This point was brought out very prominently during the inquiry which has been already referred to in 1869 in Somerset. In the district which extends for many miles round Glastonbury, the homesteads are small, and the pastures extensive; from the Tor the prospect extends as far as the eye can reach in all directions — one vast plain of feeding ground. It may be imagined how quickly the disease would spread among hundreds of cattle feeding on these pastures, and only separated by wire fences or narrow dykes; but the severe form which the affection assumed was mainly due to the want of facilities for supplying the numerous herds with sufficient aliment at a time when the system required a liberal allowance of restoratives; the sick beasts could not crop the herbage on account of the soreness of their mouths, and presumably owing to the extensive surface over which the cattle were spread, it was found impossible to supply them with food artificially prepared, or even to cut the grass and place it within their reach; at any rate it was not done, and the result was that, as it happened, on many commons and large pastures in other districts animals suffered from inanition in addition to the debilitating effects of the disease.

The system of medical and dietetic treatment which has been suggested will be applicable to all animals that are liable to the disease; but differences in the details of practice will be necessary under the varying conditions of each subject.

Sheep, although their feet are always attacked, under ordinary care, suffer much less than cattle from destructive changes in these parts, perhaps on account of the less weight which they have to sustain. There is, besides, a wonderful reparative power in the vascular membrane of the feet of sheep, which renders the loss of the entire hoof a comparatively trifling accident, capable of being rectified in a few weeks. Nevertheless, the feet of the sheep affected with foot-and-mouth complaint require considerable attention; and although it becomes almost impossible to apply remedies to all the animals of a large flock in which the disease prevails, those sheep which show by their action that they are seriously affected should be caught and properly dressed with one of the lotions previously referred to, or with a solution of one ounce of tannic acid in eight ounces of glycerine. In extensive outbreaks of disease among sheep, the application of the necessary remedies to the feet may be much facilitated by arranging a shallow wooden trough in such a manner that it may be filled with the necessary lotion, and the sheep driven through it slowly, or kept standing in it for a few minutes. This method will obviate the necessity for catching the animals and dressing them separately, except in those cases where it is apparent from the severity of lameness that the feet have suffered important changes.

Pigs, as before stated, are affected very severely both in the feet and external part of the nose. In sows the vesicles appear over the whole surface of the integument covering the udder. For obvious reasons very little can be done to alleviate the severity of the affection in these animals. Forcible administration of medicine is, as a rule, out of the question, and the most that can be done is to keep the animals in a dry, well ventilated, and sheltered position, and apply the local remedies which have been suggested to the feet and other parts which are affected.

The mortality among pigs from foot-and-mouth disease is much higher than among other animals, so that it is not uncommon to hear the malady described as a fatal disease on swine. Probably to a large extent this fatality is due to the intractable character of the animal, which induces neglect of early precautionary measures, and permits the disease to assume a severe type before it is even discovered.

Complications very frequently occur which necessitate important modifications in the plan of treatment, but it is doubtful if such cases can be properly called foot-and-mouth disease when the entire mass of blood becomes poisoned by retention and multiplication of the disease-germs which should have been excreted; the ordinary phenomena of the affection are exchanged for those which indicate various forms of blood-diseases. Splenic apoplexy, pulmonary apoplexy, cerebral congestion, formation of abscess in the areolar tissues, ulceration and sloughing of tegumental appendages, prostration and death, are the result of the non-elimination of the virus, owing sometimes to defective action of the excreting organs, but more commonly to the unscientific and obstructive treatment to which the animal is subject when the disease first appears.

Little advantage would result to the unprofessional reader, if the treatment of the complication referred to were discussed, especially as the means at our command are generally inadequate to restore the normal state of the circulating fluid, when it has once become charged with effete products, which it necessarily carries all over the system, infecting the elements of every tissue, until molecular death is followed by entire cessation of all the organic functions.

Treatment of the sick beasts must be commenced long before this condition has been established, or the time and trouble will be expended in vain.

Measures of Prevention.

If stock-owners determined to eradicate foot-and-mouth disease, there is no doubt that the object would be attained; but it is entirely useless to expect, or to base any sanitary legislation on the expectation that such a determination generally exists. A certain proportion of breeders and feeders might combine to carry out a system of prevention which promised to effect the eradication of the disease, but straightway a number of less considerate persons would take advantage of the freedom which the self-imposed restrictions on the other side would relatively afford them, to make extra profits, and thus the good intentions of the few would be frustrated. No measures which seriously interfere with trade are at all likely to be generally adopted, unless under very stern compulsion; and indeed experience proves that compulsory legislation in reference to the movement of diseased and infected animals, has little chance of being effectually carried out unless the circumstances are such as to induce the persons concerned to insist upon obedience to the law.

In the case of cattle-plague, which is the only rapidly fatal contagious disease of which we have any experience in this country, the knowledge of its destructive action induces stock-owners, with few exceptions, to assist in putting the law in force for its suppression. The other affections are either so slow in their progress as to suggest a hope of the sick animal's recovery, or they are benign in their character, and consequently excite no apprehension of loss from death of the animals attacked. Therefore, no serious determination is manifested in carrying out the regulations which have been imposed by the legislature; and the few who demand more severe restrictions than those in force, rather intend them to be applied to their neighbours' herds than to their own. The majority practically deny the necessity for any restrictive measures in respect of foot-and-mouth disease; and even if they tacitly accept them, they indicate their appreciation of such measures by disregarding, in their own proceedings, the restrictions which are intended for the repression of the disease. In short, there is no instance of persons concerned in the cattle trade being so impressed with the importance of foot-and-mouth complaint as to admit the necessity for restrictions which will interfere with their business, and subject them to loss and inconvenience.

Recently we have been suffering from a panic owing to the extensive ravages of the affection, and it is quite probable that while the excitement continued owners of cattle would have endured the inconvenience arising from restrictions on the movement of cattle for a time; but any measure, to be effective, must be of universal application; and it is vain to expect that stock-owners, in perfectly healthy districts, would consent to suffer for the general benefit, unless they could be made to understand that the probable advantage would outweigh the certain loss; and it is precisely at this point that the argument in favour of dealing with foot-and-mouth disease by severe restrictive enactments fails.

Difference of opinion as to the origin of the disease and its mode of propagation interferes with the adoption by consent of any universal system of prevention. Those who contend that the malady arises spontaneously—and undoubtedly the number of those who hold this view has much increased of late years—and others who contend that the poison is in the atmosphere, would hardly submit with patience to vexatious regulations which they believe to be useless when directed against a disease which depends on non-cognizable causes. The success of the measures which have been employed to stamp out cattle-plague and sheep-pox is chiefly due to the universal recognition of their absolute necessity and fitness. No one whose opinion has any influence doubts the fact of these diseases being foreign to our soil, in which they have never maintained a continued hold;

no one questions the possibility of eradicating them by the employment of certain severe measures which have never been known to fail when fairly applied; no one contemplates without alarm the idea of those affections becoming naturalised in this country; and therefore it is that all minor differences of opinion are merged in the common determination to get rid of the unwelcome visitants at all costs. Nothing short of a firm conviction of the danger which is impending would suffice for the carrying out of the regulations which were applied to the malignant diseases cattle-plague and sheep-pox. That similar apprehensions are not generally felt in regard to foot-and-mouth disease, is evident enough; and in their absence the only means which have proved effectual in controlling the spread of the affection will never be adopted.

In the opinion of many agriculturists, something less stringent than the cattle-plague regulations would be sufficient to rid us of foot-and-mouth complaint and pleuro-pneumonia; at best, however, it can only be said that the idea is unsupported by evidence—ten years application of the cattle-plague restrictions over the whole country did not entirely exterminate either disease. Certainly, pleuro-pneumonia existed in the London dairies during the whole time, and in several instances cattle-plague and lung-disease were combined in the same animal. Foot-and-mouth disease subsided to such proportions that it attracted no attention, and although cases of the disease were spoken of in different parts of the country, they were not thought worthy of special notice. The statement which has been so often made, that if any instances of foot-and-mouth disease had existed at the time immediately preceding the removal of the cattle-plague restrictions, they would have been recorded, is mere assumption. In the worst periods of its prevalence foot-and-mouth disease is barely noticed in veterinary and agricultural periodicals; and during the existence of cattle-plague it excited even less attention than usual; indeed, the affection was not often referred to, unless in illustration of the effect on its progress which the establishment of cattle-plague restrictions had produced. That the results of these restrictive regulations have been very much over-estimated, recent inquiry has convinced me.

Writing on the subject of foot-and-mouth disease in 1869, I alluded to the decrease of the affection under the cattle-plague regulations in these terms:—

'From this time, 1863, it gradually declined until 1865, when it recurred in a very severe form immediately upon the outbreak of cattle-plague, not unfrequently attacking the animals which were at the time suffering from that disease. Many of the cases of eczema which were examined in the autumn of 1865, presented remarkable lesions of the mouth, the abrasions of the membrane of the palate and cheeks being as extensive as they were in severe cases of plague.

'Hundreds of cattle affected with the foot-and-mouth complaint were seen in the beginning of 1866, but when the restrictions on cattle traffic were carried into effect with an increased stringency, as the cattle-plague made incursions into new districts, mouth-and-foot disease and pleuro-pneumonia declined.

'For a period of six months during the summer and autumn of 1867, the disease was seldom seen; the cattle in the Metropolitan market and in the lair, were free from the affection, and a like immunity from its attack was enjoyed by animals all over the country. Isolated cases might be met with, but it is certain that, at the time of cessation of the cattle-plague, the live-stock of the United Kingdom were more entirely exempt from infectious disease than they had been for many years.'

These remarks were written without any intention to prove that foot-and-mouth disease had been absolutely exterminated by the measures which had been used for the eradication of cattle-plague. It was generally known at the time that the disease had subsided to a remarkable extent, and its absence from the lairs of the metropolitan market naturally attracted attention, but it was never suspected, and certainly it was not intended to suggest, that the malady had altogether ceased. On the contrary, it was known to exist among cattle in different parts of the country while the cattle-plague regulations were in force. These regulations, in reality, commenced to operate on March 24th, 1866, when foot-and-mouth complaint was very prevalent, but less so than in 1865. The Order of March 24th, 1866, provided that fairs and markets for sale or exhibition of cattle should be held only by licence, that foreign cattle should not be moved from the town or place in which they were landed, and cattle brought by sea from any part of the United Kingdom could not be moved from the town or place alive without a certificate of health, only to be granted after proper inspection.

Cattle could not be moved on a highway between sunrise and sunset; no movement of cattle was permitted on a highway, railroad, or river, without a licence; and even hides, and horns, or hoofs, were to be conveyed under strict supervision. These restrictions were continued, and even made more severe from time to time until June, 1868, when they were revoked in reference to all parts of the country excepting the metropolis, which was not set free until the opening of the Deptford Market in January, 1871.

It appears, therefore, that the cattle-plague regulations were in operation for more than twelve months, that is, from the spring of 1866 to the summer of 1867—before the decline of foot-and mouth-disease was so marked as to excite any remark. Accidental reference to my notes of 1867 has just reminded me that, in the beginning of 1867, while the regulations were most rigidly enforced, I investigated an instance of foot-and-mouth disease at Thirsk of so virulent a kind that it was suspected to be cattle-plague. One animal died about the time of my arrival, and an examination of the herd, which was entirely composed of Irish stores, showed that the disease had attacked nearly the whole of them, and was rapidly running its course, notwithstanding the extreme coldness of the season, and the presence of a deep snow in the pastures where the animals were placed.

Mr. Rayment, the Inspector of the Metropolitan Market, has just given me some extracts from his note-book in reference to the existence of foot-and-mouth disease in the Market in 1867, observing, at the same time, that he only noted instances of its unusual prevalence.

On January 10th many animals were found to be affected. March 14th another entry occurs, in which the state of the disease is indicated by the terms "rather prevalent." Again, on March 18th and on April 8th, a similar entry occurs. On April 18th the record is, "Foot-and-mouth disease very prevalent." May 13th a similar entry. After which no more remarks occur until the latter part of the same year, when my attention was called by Mr. Rayment to the peculiar form which the disease had assumed among the cattle in the lairs. The lesions in the mouth were most severe, resembling those of cattle-plague. For some months previously no cases of the disease had been recorded as having occurred in the market lairs, and if Mr. Rayment had not observed the unusual character of the diseased parts no special notice would have been taken of it then.

In the winter of 1867 the first cases of foot-and-mouth disease in the lairs of the Metropolitan Market were detected in English beasts; from that period attacks became gradually more numerous, even while the cattle-plague regulations were in force, and a still more rapid extension of the malady was observed when they were revoked in June, 1868. During 1869, 1870, 1871, and part of 1872, the disease raged with remarkable force, and did not subside until the autumn of 1872. And now at the end of the summer of 1873 it has attained a position as low as it ever reached during any period of the operation of the cattle-plague restrictions.

Even if it were admitted, however, for the purpose of argument, that cattle-plague and foot-and-mouth disease were simultaneously extirpated by the action of the restrictions which were in force, the fact remains that the result was gained by means which could only be justifiably used in the presence of such an emergency as an outbreak of cattle-plague. On the other hand, if it be maintained that the foot-and-mouth disease survived the plague, and it is a matter of certainty that it did, it follows that even cattle-plague restrictions would not be absolutely effectual; and in any case there is nothing to justify the belief that less severe measures would succeed.

The presumption that legislation of a much less restrictive character may diminish the rate of progress of the disease without seriously interfering with the free movement of animals, has, in fact, been entirely negatived during the last three years, when foot-and-mouth disease has prevailed to a remarkable extent in the presence of restrictions quite as onerous as public opinion permitted, and even too severe to enlist general sympathy, or ensure general compliance, yet no impression was made on the progress of the disease, chiefly, it is admitted, for the reason that the provisions were not enforced; nor could they be enforced. All that has ever been advanced in proof of the determination of the local authorities to carry them out is included in the statement of the number of convictions which had been obtained against persons who infringed them.

The plain truth of the matter is, people will not submit to restrictions directed against an evil which they do not recognise to be of sufficient importance to call for interference; and, plainly enough, stock-owners do not care enough about the prevention of foot-and-mouth disease to take the most simple and obvious precautions against it. The cry has always been, let us be secured from importation of foreign diseases, and then let us alone. In the mind of any unprejudiced inquirer no doubt can exist that this feeling is almost universal among farmers, a few breeders of pedigree stock alone being excepted.

No hesitation can be felt in admitting the reasonableness of the claim to be protected against the introduction of the disease from abroad; and the legislative restrictions on the foreign trade are based on a clear recognition of the claim. The measures which are enforced at all the ports where foreign animals are landed, are excessively severe, and their operation has been so effectual, that for one outbreak which has been traced to the movement of infected foreign stock, a thousand outbreaks have been traced to the movement of diseased animals from one part of the United Kingdom to another; and such movement could not have been prevented without producing positive stagnation in the cattle-trade, which would have caused more injury than the unrestricted spread of the disease.

Restrictions on the importation of foreign animals are justifiable on the ground that they form a comparatively small proportion of our total supplies, and are only beneficial to us so long as they do no mischief; but the suggestion which has been often made to deal with Irish stock in the same way as foreign animals are dealt with is quite unpractical and never was seriously advanced. Ireland is our great source of supply of store stock, and whether the animals are healthy or diseased, we must have them. This fact is well known, and both in theory and in practice admitted. The prevalence of foot-and-mouth disease in Ireland recently did not in the slightest degree affect the price of Irish stock, nor lessen the demand for them in this country; and those who were loudest in their demands for stoppage of importation or the adoption of restrictions which would have amounted to the same thing, would have been the most appalled had their suggestion been accepted and acted on. The Irish cattle-trade cannot be placed on the same footing as the foreign cattle-trade, for the paramount reason that the circumstances are essentially different in the two cases. Foreign animals are in no way under our jurisdiction or control until they are landed on our shores; we cannot regulate their treatment in the countries whence they are exported, and therefore our only chance of safety lies in the establishment of severe restrictions, which shall deter the exporter from sending diseased stock, and protect us, as far as possible, from infection if diseased animals are landed. Regulations framed on this principle have been in force for some time past, and it is sufficient to say of them that they have been generally effectual in securing the object for which they were established.

In the United Kingdom we possess the power to apply sanitary regulations to our flocks and herds, and our aim should be to attack such an affection as foot-and-mouth disease in its centres; in fact, it should be the care of every stock-owner to deal with the malady in such a manner that the risk of propagation should be reduced to a minimum. Legislation on the subject may well be limited, as it now is, to those sections of the Act which provide that diseased animals shall not be exposed in public places or otherwise dealt with so as to inflict injury on healthy animals. Further than this, sanitary law, as respects foot-and-mouth disease, it would seem from our experience, cannot be successfully carried; and the actual details of measures of prevention must be left to the energy of the individual who is most concerned, the stock-owner, directed by the veterinary surgeon. Two words, isolation and disinfection, taken in their extended sense, include all that can be said on the subject of prevention. The disease is not fatal, and therefore there is no justification for the adoption of the stamping-out system, as it is applied to cattle-plague. Considerable loss is, however, inflicted on the grazier and the dairyman, and therefore it is important to employ all sanitary means to regulate the course of the disease, to moderate its severity, and to prevent its extension.

Veterinary science is quite competent to deal effectively with animal plagues, if stock-owners choose to avail themselves of its aid; but it is futile to anticipate any advantage from the adoption of a system of empirical treatment directed by uneducated men, whose chief idea is to cure the sick beast by antiquated nostrums; while the subtle infection is allowed to extend its area of operations unchecked. Sanitary regulations, many of them restrictive in their nature, are required in all cases of outbreaks of foot-and-mouth disease; but they must, to be effectual, be applied by the owner, or with his full concurrence.

Immediately on the discovery of the disease in a herd, it becomes necessary to decide whether the attempt is to be made to limit the affection to the animals among which it first appears, or the disease is to be allowed to run its course. If the circumstances are such as to render the chances of escape of the stock on the farm very slight, direct communication of the contagion by simply introducing a little of the saliva of the sick animals into the mouths of the healthy ones on a tuft of hay is the most effectual way of getting quickly over the trouble, while the disease, thus induced, is almost certain to be mild in its character. This method of conveying the affection to all the animals which, in the natural course of things, are likely to be attacked, is far preferable to permitting the association of diseased with healthy animals, which will indeed be ultimately attended with the same result, attained, however, in an irregular manner, and at the expense of considerable time and anxiety.

On the other hand, if the affection be detected among newly purchased stock, or if it occur among fattening beasts or dairy cows, it is of the first importance to prevent its spread, by isolation of the sick animals, and the use of disinfectants; but even in these instances, if the affection shows an unmistakable tendency to extend, inoculation with the saliva is to be recommended. Whatever course the stock-owner may determine to adopt in reference to the management of his own herd, the commonest consideration for the welfare of the stock in the neighbourhood will prompt him to give immediate notice of the outbreak on his farm to his neighbours, in order that they may protect their animals from infection as far as possible, and next, he will deem it a matter of duty, as well as to his own interest, to limit the disease to his own stock by strict attention to sanitary regulations. The premises, on which the disease exists, should be treated as an infected place by the occupier and his servants. Sick animals should be completely isolated, whether the disease has arisen naturally, or has been communicated intentionally in the manner suggested. All the secretions from such cattle should be disinfected or destroyed; milk from cows affected with the disease should be well boiled before it is given to pigs; all the manure and sweeping of the sheds should be mixed with quick-lime, and a solution of some disinfectant, as carbolic acid, one part to fifty of water, or common alum-water, may be used to wash the mouth, nostrils, udder, and feet of the sick animals, and thus destroy the virus at its source.

When cattle are on the pastures it is difficult to apply these measures effectively, but even under such unfavourable conditions the disinfecting solutions may be employed to disinfect the manure in the field, and also may be applied to the parts of animals whence discharges issue by means of a syringe when close approach to the animals is not possible.

In this country it is not easy to compel the disinfection of the attendants on sick cattle, who do often more mischief than the animals themselves; but the farmer who is anxious to limit the spread of the malady should be alive to the importance of avoiding this source of danger if possible; and if, in carrying out the necessary precautions, he can, by exhortation or entreaty, cause the attendants to wash their hands in a little alum-water, and tread in some lime every time they leave the sick cattle, or the places in which they are kept, he will have the satisfaction of knowing that he has done good in more ways than one.

Active legislative measures in respect of foot-and-mouth disease will most probably in future be confined to regulating the movement of diseased animals on public roads, the careful watching of fairs and markets, the disinfection of pens and places in which diseased animals have been kept for sale or during transit, and the application of stringent restrictions to imported animals. The management of the disease among home stock will, therefore, devolve on the farmer, who may, if he chooses, effect far more than ever could be done by oppressive enactments which cannot be enforced.

Agricultural Societies and Chambers of Agriculture might do good service by recommending, and, as far as their influence extends, ensuring the adoption of precautions against the introduction of foot-and-mouth disease, and the control of its extension where it has appeared.

First in importance among sanitary regulations is the separation of newly purchased stock from the stock on the farm for several days. Next, in the event of disease appearing, it should be a special object with the owner of the infected herd to confine the affection to his own premises, and then to decide whether he will endeavour to arrest its spread, or assist it by inoculation. Prevention is possible where facilities exist for isolation of sick animals, and the frequent and extensive use of disinfectants. In some instances where foot-and-mouth disease has appeared in cowsheds, the constant use of sawdust saturated with carbolic acid on the floor of the shed has been followed by the cessation of the disease after a few animals have been attacked, and there is no doubt that even the malignant cattle-plague was kept in check in several instances by the constant employment of carbolic acid, although the animals succumbed as soon as they were removed from its protective influence.

Other agents may be equally efficacious when carbolic acid is objectionable. Chloride of zinc, chloride of lime, chlorine gas, sulphurous acid gas, are all valuable under different circumstances, and the list may be extended according to the experience of the person who has the sanitary charge of the district where the malady prevails. All the measures employed must be based on the principle of guarding against the introduction of disease by quarantine of newly purchased stock, and preventing its spread by isolation and disinfection. Every diseased animal must be treated as a manufactory of the specific poison, and every individual and substance which comes in contact with the animal as a probable medium of its extension.

The question will always return, is foot-and-mouth disease an affection of such a serious character as to render this degree of circumspection necessary or desirable? And the answer must be left to the agriculturists of the kingdom. If they decide that the object is worth the cost, there need be no difficulty in carrying out the regulations which have been suggested.

XIX.—*Report on the Contagious and Infectious Diseases of Animals referred to in the Contagious Diseases (Animals) Act*, 1869, *especially with respect to their degree of prevalence in* 1872. By Professor G. T. Brown, Chief Inspector of the Veterinary Department.

[Reprinted from the Report of the Veterinary Department for the Year 1872.]

Cattle plague, pleuro-pneumonia, foot-and-mouth disease, sheep-pox, sheep-scab, and glanders are the maladies which are enumerated in Section VI. of the Act, in explanation of the term "contagious or infectious disease." The section gives power to the Privy Council to declare from time to time any disease to be a contagious or infectious disease for the purposes of the Act, but it has not yet been found necessary to add to the list.

Owing to the modifications which result from certain conditions of climate it is occasionally the case that an outbreak of an entirely new disease is reported, but, on inquiry, it has always been found that the novel affection is a well-known malady, slightly altered by the circumstances of the locality in which it has appeared. Climate undoubtedly affects the development of various maladies to a considerable degree. There are certain affections, for example, in Eastern Europe which appear to spread by contagion. These affections, as they are represented in our country, are usually confined to the localities in which they appear, and never extend to a distance in the way that ordinary infectious and contagious diseases are known to do.

Various forms of blood disease which are known by the terms "anthrax" or "charbon" seem to be highly infectious in some parts of the continent, and instances have occurred, even in Ireland, of the spread of these maladies apparently from infection. But in England this peculiarity has not been observed. These diseases very commonly occur under certain conditions of soil and management of animals, but they never extend beyond the district and seldom beyond the premises in which they arise.

Contagious and infectious diseases are presumed to be communicated by means of certain "germs," in which the contagious property resides. The term "contagium" has been suggested by Dr. Beale as a convenient one for the purpose of expressing this quality.

Sometimes it is necessary for actual contact to take place either between the healthy and diseased animal, or between the healthy animal and some of the secretions or excretions from the sick one. In other cases it appears that the particles of contagium are so exceedingly minute that they may be conveyed in the animal's breath, the exhalations from the surface generally, and may be wafted by the atmosphere to a considerable distance.

The term "volatile" which has been used to express this ready diffusibility of the contagium is by no means well chosen. Indeed it is almost certain that the assumption of the gaseous form would necessitate the destruction of that vitality on which the activity of contagium depends.

Considerable mystery commonly attends the progress of an infectious malady. An outbreak occurs in a particular part of a district; a number of animals in the immediate neighbourhood are affected in the ordinary course of the disease, and there is no difficulty in tracing the methods of communication of the contagium from the original centre. But suddenly the disease appears in a new district some miles distant from the place where the outbreak occurred, and no communication whatever can be shown to exist between the two localities.

In such instances it is sometimes discovered, and it may be generally assumed that the "contagium" has been conveyed indirectly by the agency of persons or substances which have been in contact with the diseased animals.

This view, however, does not satisfy all observers, and it consequently happens that a large number of persons believe, in reference to all infectious maladies, that they do not possess the property of communication by contact, but are disseminated in accordance with certain peculiar atmospheric conditions, the nature of which, however, they do not profess to understand. During the progress of the cattle plague many persons held the belief that the disease was in no way infectious or contagious, and they manifested their indifference to the consequences of indirect communication between sick and healthy stock by passing freely from one to the other. In a great many instances the result of this course of procedure was, as might be expected, communication of the disease to the healthy animals; but in some few instances herds which were so injudiciously treated nevertheless escaped.

Setting aside certain exceptions which occasionally present themselves, and to which more than necessary importance is often attached, it is true that contagious and infectious diseases spread in obedience to the operation of well-known laws, that they assume a virulent form when their course is unrestricted, and that they may be, with almost absolute certainty, exterminated by the application of stringent measures.

This statement is made with confidence, notwithstanding the allegation that the operation of the Contagious Diseases (Animals) Act has not materially influenced the spread of infectious and contagious diseases among the stock of our own country. Admitting the allegation to be true, it is not difficult of explanation. In the first place, as far as personal observation enables me to decide, the Act has not been carried out effectually in any one district, to say nothing of the whole country. The most energetic action which I have witnessed has consisted simply in the punishment of offenders against the law—a proceeding which, however desirable, obviously can have little influence in preventing the spread of the disease which has been occasioned by the negligence of the offending parties.

Again, the sanitary care of the stock of the country, which should be placed in the hands of veterinary surgeons has been very generally left to the police, who, however valuable as assistants in carrying out the details of the various sections of the Act are quite incompetent to detect the existence of disease, to decide as to its nature, or advise in reference to the curative or preventive measures which may be necessary.

The fact that additional veterinary inspectors are appointed immediately on the appearance of the cattle plague in the country is of itself a proof that the local authorities admit the value of professional aid. Considerable additional expense would undoubtedly attend the employment of professional men as inspectors all over the country, and it is presumably on this ground their services have been generally dispensed with. The objection, however, has nothing to do with the fact which has been stated, namely, that the Contagious Diseases (Animals) Act has not been fairly tested, excepting on those occasions when the prevalence of cattle plague or sheep-pox rendered it absolutely necessary that its provisions should be systematically and energetically enforced, and on those occasions it has always proved equal to the extermination of the diseases, notwithstanding that the imperfection of some of its sections has caused unnecessary delay in the adoption of the measures of repression.

The record of the contagious and infectious diseases of animals for 1872 has a distinctive character owing to the outbreak of cattle plague in Yorkshire, the history of it will occupy the most prominent position in this Report.

The History of the Outbreak of the Cattle Plague in Yorkshire.

It is a remarkable circumstance that cattle plague was first detected in the neighbourhood of Pocklington, the place into which it was last introduced. Its existence for some time previously in the districts of Patrington and Bridlington was altogether unsuspected. The presence of cattle plague in an important agricultural county for a period of at least a month before it was detected, was in all probability due to the accident of its appearance in places where few cattle where congregated together, and where consequently only single cases of the affection occurred at intervals.

The usual reticence of stock-owners in reference to the existence of disease among their animals will in some measure explain the concealment of the malady; and the slaughter of diseased animals by the butcher naturally retarded its spread although it failed to completely extinguish it.

When cattle plague attacked a large herd and was left to run its course unchecked under the impression that it was the common foot-and-mouth disease, the discovery of its true nature necessarily followed the observation of ravages.

As soon as intelligence of the outbreak near Pocklington was received an investigation was commenced, and, step by step, all the important particulars were elicited.

Meanwhile, evidence, which was sometimes incomplete, often contradictory, and more than once misleading, had to be examined, and it was only after some weeks had been spent in the investigation that sufficient facts were collected to justify the formation of a definite opinion as to the origin of the disease.

Before the report of the outbreak in Yorkshire was sent to the Veterinary Department, it was well known that the risk of the introduction of cattle plague had been several times incurred by the importation of Russian cattle, suffering from the affection, during the month of July; and it will be desirable, in order to give a connected account of the circumstances attending the transmission of the disease to home-bred stock, to refer briefly to the importation of plague-infected cattle into the ports of London, Hull, Hartlepool, Newcastle-upon-Tyne, and Leith.

Mr. Nissler, cattle-dealer, of Cronstadt, purchased, during the summer, a large number of cattle in St. Petersburg market.

From St. Petersburg the animals were sent to Cronstadt, in order that vessels which were compelled to take in only part of their cargo at St. Petersburg owing to the insufficient depth of water might call at Cronstadt, and take in their complement of cattle to convey them to England, and elsewhere. About 50 of the cattle were shipped to Lubeck, where they arrived on the 17th July; from Lubeck the animals were sent by rail to Hamburg, and on their arrival were driven to a field at Lockstedt on the Holstein frontier. Forty of them were afterwards shipped to Hartlepool, Newcastle, and Hull. Of the remaining ten, one died and nine were slaughtered by the butcher who bought them.

The outbreak of cattle plague in Hamburg was traced to the presence of these Russian animals in the meadows at Lockstedt. The disease rapidly spread to a large herd of German cattle which were grazing in an adjoining field. On the 26th July one of these cattle was found dead. On the next day two more were very ill, and were killed, and on the 5th August the remainder of the herd were destroyed as well as seven beasts in an adjoining field.

Subsequently 38 of the Russian cattle were sent to Berlin, where they were seized by the authorities, and immediately destroyed, in consequence of cattle plague being detected among them. The rest of the animals were sent to this country with the exception of about 50, which appear to have been sent to Cronstadt, and sold there. The infected cargoes arrived here in the following order:—

On the 17th July the 'Leda' brought 25 cattle from Cronstadt to Deptford market. No disease was detected among those animals when they were first landed, but before the period of detention had elapsed one of them died, and on a post-mortem examination lesions of cattle plague were evident.

On the 21st July the 'British Queen' arrived at Hartlepool from Hamburg with a cargo of cattle and sheep. Some of the cattle were Russian animals, and one of them, there is every reason to believe, was the subject of cattle plague, although the disease was not officially declared, in consequence of the animal having been slaughtered by the owner without the inspector's knowledge or consent. All the animals of this cargo were slaughtered within the defined part, the sheep as well as the cattle, in consequence of foot-and-mouth disease having been detected soon after the animals were landed..

On the 22nd July the 'Brigadier' from Hamburg arrived at Newcastle-upon-Tyne with a cargo of 70 German and 8 Russian cattle. The German cattle were healthy, with the exception of two, which were suffering from foot-and-mouth disease. One of the Russian cattle was ill, and died soon after being landed. In this case also the inspector found the characteristic evidences of cattle plague on a post-mortem examination. All the animals were slaughtered in the defined part of the port, and the carcases of the plague-infected animals were disinfected and sent in charge of an officer to a manure manufactory and there destroyed by immersion in vitriol. It was afterwards ascertained that one animal of this cargo had died on the voyage and been thrown overboard.

On the 23rd July the 'Benachie' from Cronstadt arrived at the port of Leith with 50 Russian cattle on board. On making an inspection of these animals on board the ship the inspector discovered that 13 of them were the subjects of cattle plague. These animals were slaughtered and thrown overboard at sea many miles from the land, under the superintendence of the veterinary inspector of the port. The rest of the animals of the cargo were slaughtered on board, and the carcases were removed in lighters, taken out to sea, and thrown overboard. It would appear that the majority of the carcases so treated were carried out to sea, as only portions of offal and parts of carcases were subsequently washed ashore on the Scotch coast.

On the 25th July the 'Joseph Soames,' from Cronstadt, arrived at Hull with 56 Russian cattle on board. This vessel with its cargo will be referred to in another part of the Report.

On the 28th July the 'Viatka,' from Cronstadt, arrived at Deptford with 35 Russian cattle on board. This vessel had taken 40 animals on board, but five of them had died during the voyage and been thrown overboard. On an inspection being made of the animals immediately after they were landed at Deptford three of them were found to be affected with cattle plague in its early stage, and before the slaughter of the cargo could be completed several others gave evidence of being affected. The diseased animals were slaughtered, and the carcases were destroyed by being placed in large iron digesters (which are provided for the purpose in the Deptford market) and submitted to a high temperature by the introduction of condensed steam. The offal and skins of all the animals were disinfected.

On the 29th of July the 'Brigadier' returned to Newcastle-upon-Tyne from Hamburg with 103 German cattle on board. The veterinary inspector on examining these animals detected cattle plague among them. The cargo was accordingly dealt with as the previous one had been. It is evident that these animals must have been infected when they left the port of Hamburg.

On the 29th July the 'Gipsy Queen' arrived at West Hartlepool from Hamburg with 26 German cattle on board. None of these animals were observed to be ill when they were first landed, but before the period of detention had elapsed several of them gave evidence of being infected with cattle plague. All the cattle were slaughtered, the carcases were disinfected and buried by order of the local authority under the superintendence of the veterinary inspector. It is scarcely necessary to remark that in all instances the vessels which brought plague-infected animals into a port were cleansed and disinfected under the direction of the veterinary inspector before being "cleared," and it appears that in every instance but one, the means which were adopted to prevent the communication of cattle plague to animals in this country were effectual.

The history of the cargo of Russian cattle which introduced the cattle plague into Yorkshire may now be proceeded with.

In July last year, the landing of animals infected with cattle plague from Russia at the Deptford market, led to the passing of an Order of Council prohibiting the importation of Russian animals. Before the Order came into force, however, several cargoes of cattle which had been shipped at Cronstadt were on the sea, bound to English ports. The 'Joseph Soames,' the ship in which we are most interested, left Cronstradt on July 16th with 58 cattle on board, and a general cargo consisting of iron, to be shipped to New York; cow-hair and wool for Antwerp and Dunkirk; hemp, wood, tow, wheat, mats, and bags destined for Hull, from which port the other part of the general, cargo was intended to be shipped to America, Belgium, and France.

On the second day after leaving Cronstadt one of the cattle died, and was thrown overboard. On the fourth day another animal died, and was also thrown overboard. Both those animals were examined, and it was stated that they were found to have died from choking, but subsequent events justified the conclusion that both of them were affected with cattle plague. On July 25th, the vessel arrived at Hull and entered the Humber dock early in the morning of that day. Immediately on the arrival of the ship the customs' officer went on board; information was sent to the veterinary inspector, who immediately attended, and, after examining the 56 cattle, reported that some of them were affected with cattle plague. The Order of Council referred to previously was then in force, and the animals consequently were not permitted to land. Meanwhile, the passengers, eight in number, and also the crew, went on shore. The ship was left in charge of a customs' officer, and information was immediately telegraphed to London by the veterinary inspector, who required instructions as to the disposal of the cattle. Directions were given to prevent communication with the shore, but, notwithstanding all that was done, there is no doubt that frequent communication took place. Persons concerned about the cattle visited the ship, and while the vessel was lying in the dock the removal of the general cargo from the hold was continued. On Friday, July 26th, I proceeded on board the 'Joseph Soames,' accompanied by Professor Simonds, and after making a careful examination of all the cattle, we ascertained that 18 of them presented decided evidence of being affected with cattle plague. Under these circumstances it became absolutely necessary that the whole of the cargo should be slaughtered and the carcases in some way destroyed. At this point a serious difficulty arose. The defined part of the port of Hull includes the landing-places, the Customs' depôt in Bath Place, and several slaughter-houses in that part of the town which is nearest to the places where the cattle are landed. No ground was available in which carcases could be buried without previously being taken through the streets of the town; and within the defined part there existed no appliances for the destruction of them by burning or boiling. The only course that presented itself was the sinking of the carcases at sea, and after communication with the local authority, whose inspector was in attendance from the first, it was decided to slaughter the animals on board the vessel, pack the carcases in lighters, and sink them, in accordance with the terms of the Order, more than three miles from the British coast. Steps were immediately taken to carry this intention into effect; all the animals were slaughtered on board on July 27th, the carcases were packed in two lighters, battened down, roped across, and at high tide about 11 o'clock the same night they were towed out to sea. The means employed to sink the lighters proved to be quite inadequate, and they were finally turned adrift. Information of the event was communicated to me on July the 28th, about the middle of the day, by the officer of the local authority who had been sent out in charge of the carcases. Notwithstanding that I was fully aware of the grave error which had been committed in not bringing the lighters back again into the Humber, when it was found that the appliances for sinking them were not sufficient, I was unable to suggest any remedy. It was anticipated that the carcases, and most probably the lighters in which they were placed, would be stranded on some part of the English coast, but previous experience of such an occurrence did not justify any serious apprehension of its consequences.

One of the lighters and all, or nearly all, the carcases were subsequently cast ashore on various parts of the Lincolnshire and Norfolk coasts.

On the morning of the 29th July one of the lighters was seen about eight miles from the shore at Dimlington. On Friday the second of August, this lighter, marked "W. Brown, Hull, No. 9," with 40 carcases, was washed ashore at Huttoft, on the coast of Lincolnshire, in the port of Boston. On August 28th it was reported that a number of carcases of Russian cattle had been washed ashore on the north-west coast of Norfolk, and between the 8th and 30th of August the returns of the Receiver of Wreck mention six carcases which were washed ashore in the port of Wells.

All these carcases were buried under the direction of the Customs authorities in accordance with the conditions of the Order of Council relating to the burial of carcases. The actual number stranded is 55, of which 48 were washed ashore in Lincolnshire at Boston and Grimsby, and 7 at the port of Wells. On the assumption that all these animals came from the 'Joseph Soames' only one carcase remains to be accounted for. It is not, however, absolutely clear that all the carcases were those of the Russian cattle. In any case it can now be confidently asserted that no outbreak of cattle plague occurred in any part of the country where the carcases were stranded.

Some weeks passed after the last carcases had been buried, and it was anticipated that all danger had passed, when intelligence of the alleged existence of cattle plague among a herd of 22 cattle belonging to Mr. Berryman, of

Yapham, near Pocklington, in the East Riding of Yorkshire, was telegraphed to the Veterinary Department.

An investigation was immediately ordered, and Mr. Wilkinson, Veterinary Inspector, of Newcastle-on-Tyne, was instructed to proceed to Pocklington, which place he reached on the evening of the day on which information of the outbreak was received in London; and, after inspecting the diseased cattle, he had no hesitation in reporting that they were suffering from rinderpest. All the regulations of the Contagious Diseases (Animals) Act, 1869, and the Orders relating to cattle plague were directly put in force. The whole of the cattle forming the infected herd were killed and buried, the proceeding occupying the greater part of the two following days, and the district was declared "infected" by the local authority.

On my arrival at Pocklington I ascertained that a considerable number of cattle belonging to different owners had been pastured in the fields adjacent to Mr. Berryman's lands. Some of these cattle had been removed by the owners before the nature of the disease among Mr. Berryman's cattle was known, but there was reason to apprehend that they had been exposed to the infection. On this presumption I pointed out to the local authority the risk which was incurred of the spreading of the disease; however, as the cattle had not been in contact with the diseased animals, it did not appear that they could be slaughtered by order of the authorities. They were all included within the boundaries of the infected district, and could consequently be kept under supervision.

It is a matter of absolute certainty that at the time of my visit the infection had actually extended to some of the herds referred to, although no indication of disease was detected until a week after the slaughter of Mr. Berryman's herd.

The cattle plague extended by degrees from Yapham until it reached the stock on a farm about five miles distant, and notwithstanding the active steps which were taken by the authorities of Pocklington to carry out the law, the plague was not finally extinguished until the last week in October.

At the commencement of the investigation the following particulars referring to the introduction of the disease into Yapham were furnished to me by Mr. Berryman:—

On August 19th Mr. Berryman bought, at Hunmanby market, 22 cattle of Mr. Woodcock of Bridlington, who had 26 cattle in the market for sale. On the same evening the 22 beasts bought by Mr. Berryman were driven to Driffield, a distance of 14 miles, and pastured in a field by themselves, near the Falcon Inn. The next day the animals were driven to Pocklington, a distance of 16 miles, and placed in Mr. Berryman's paddock outside the town. On the following day they were driven a distance of two miles to fields in Mr. Berryman's occupation at Yapham, where they remained. Mr. Berryman did not see the animals for two or three days after their arrival at Yapham, and when he did visit the pastures in which they were kept, he did not like the appearance of several of them. However, expecting an outbreak of foot-and-mouth disease, he was not alarmed at the slight signs of illness which he detected. Nothing of consequence occurred until August 27th, when the herdman informed Mr. Berryman that two of the cattle were very ill. On the next day one of the beasts was in a dying state and the other suffering severely. Both these animals died shortly afterwards.

The symptoms which Mr. Berryman noticed were diarrhœa, discharge from eyes and nostrils, and soreness of mouth. Veterinary aid was sought, and the sick animals were placed under treatment. The disease rapidly spread among the herd, several beasts died, and the veterinary inspector of the district was led to suspect the existence of cattle plague. Owing to the report which he sent to the local authority a meeting of the magistrates was held on

September 3rd, and a telegram was sent to the Veterinary Department of the Privy Council reporting the existence of cattle plague in the district.

Before the disease was officially declared, 8 cattle of the herd had died, 11 others were affected, and only 3 were reported free from disease.

From these facts it was evident that one or more of the 22 animals bought at Hunmanby market on 19th August, must have been infected at or about the time of purchase. It consequently became absolutely necessary to ascertain whence the animals which were in the market on that day had come, aud in what way they had all been disposed of.

The market at Hunmanby is held chiefly for the sale of fat stock, and I was assured that the 26 cattle sold by Mr. Woodcock were the only store cattle in the market on August 19th. Accordingly my inquiries had special reference to those animals. Before I left Pocklington I was informed that at least two of the lot of 22 bought by Mr. Berryman at Hunmanby had been in possession of Mr. Taylor, of Sewerby Cottage, Bridlington. It was also stated that these animals had been bought by Mr. Taylor in Hull market, where they had been sent from Lincolnshire. By a very obvious process of induction the theory was at once established that cattle plague had been first introduced into Lincolnshire through the agency of the carcases of diseased Russian cattle which were stranded on the Lincolnshire coast after having been removed from the 'Joseph Soames' and put in lighters for the purpose of being sunk at sea.

This explanation of the origin of the cattle plague in Yorkshire was unhesitatingly adopted, and although subsequent inquiry proved it to be entirely erroneous, the idea that the infection emanated in some way from the stranded carcases is still to some extent entertained. Disregarding the solution of the difficulty thus suggested, I proceeded to Bridlington under the conviction that cattle plague had existed on Mr. Taylor's farm before the animals which he sold to Mr. Woodcock were sent to Hunmanby market, a conviction which was strengthened by the evidence obtained immediately on my arrival at Bridlington, where, as I afterwards discovered, cattle plague was then existing in several places.

The primary object of inquiry was the origin and destination of the lot of 26 store cattle sold by Mr. Woodcock at Hunmanby on August 19th. Some time was occupied in completing the inquiry, but the result may be written in a few words.

Mr. Woodcock bought 26 cattle of Mr. Wise, near Bridlington, who had grazed them during the summer. All these animals, however, and all Mr. Wise's stock may be at once exempted from suspicion.

Mr. Woodcock next sold three of the lot for slaughter in the town. Then, in the course of his trade as a dealer, he bought three cattle of Mr. Taylor, which three animals corresponded, as Mr. Woodcock believed, with the three which Mr. Taylor had bought in Hull market on August 12th. In fact, however, only two of the three Hull beasts were sold by Mr. Taylor to Mr. Woodcock. The other one was sold to Mr. Woodcock's brother, a butcher at Bridlington, a few days after it reached Mr. Taylor's premises, and its place was supplied by one of Mr. Taylor's own stock.

The three Hull cattle sold in the market on August 12th to Mr. Taylor were traced to the farms from which they had been sent to Hull, and it was ascertained that no disease of any kind had existed on those premises either before or after the cattle were sent to Hull market.

It thus appears that the lot of 26 beasts sold at Hunmanby on August 19th was composed of 23 cattle bought of Mr. Wise, two which Mr. Taylor had bought in Hull market on August 12th, and one of Mr. Taylor's own stock. Coincidently with the obtainment of this evidence the fact transpired that a disease, which Mr. Taylor suspected to be pleuro-pneumonia, had existed on his premises for some time past, and had induced him to get rid of nearly all his stock.

Of the lot, 26 in number, so constituted, Mr. Berryman bought 22, namely, 20 of the cattle which had been grazed by Mr. Wise, and the two Hull beasts (marked by a scissors' clip) which had been on Mr. Taylor's farm for some days. The other four beasts of the lot of 26, namely, three of Mr. Wise's and one of Mr. Taylor's, were bought by Mr. Robinson in Hunmanby market on August 19th, and by him sold again directly to another dealer.

These four cattle which were placed with a number of others were afterwards traced by Professor Simonds to a park near Leeds, and found to be in good health.

The Hunmanby lot of 26 beasts being accounted for, the inquiry into the origin of the malady at Pocklington may be continued.

Suspicion at once pointed to Hull as the original centre of the outbreak. In the last week of July 18 Russian cattle affected with plague had stood on board the 'Joseph Soames' which was lying in the Humber dock so close to the quay that the Customs officer, on one occasion, went on board without using a boat, merely stepping from one vessel to another. Communication of the infection to cattle in the town, by indirect means, might at least be assumed as a probability; and the concealment of the disease, the slaughter of the sick animals, and the exposure for sale in the market of the apparently healthy animals which had been herded with them, were circumstances which at once suggested themselves as simple and natural consequences of the first assumption. Three markets had been held at Hull between the time of the removal of the carcases of the plague-infected cattle from the 'Joseph Soames' and the sale of the Hunmanby lot, and the serious question presented itself, "What has become of the cattle sold on July 29th, August 5th, and August 12th, in Hull market?"

No time was lost in prosecuting this essential inquiry, in the conduct of which Mr. Shorten, Veterinary Inspector of the Port of Hull, rendered valuable assistance. Meanwhile the suspicion of an outbreak of cattle plague on Mr. Taylor's farm some considerable time prior to August 19th assumed the character of a positive fact. First, it was a matter of observation that Mr. Taylor had got rid of nearly all his stock, and amongst other animals, he had sacrificed at a butcher's price a valuable heifer which had obtained several first prizes, and was expected to gain others.

Next, Mr. Taylor admitted that he had reason to apprehend the existence of pleuro-pneumonia among his stock, and on that account considered it advisable to get rid of them.

Thirdly, his valuable bull died on Wednesday, September 4th, after a short illness, and two cows which had been sent to this animal on August 31st, were seen by me to be suffering from cattle plague on September 9th.

Under those circumstances I felt justified in assuming that the disease which Mr. Taylor suspected to be pleuro-pneumonia, was in reality cattle plague which he had introduced among his stock with cattle bought by him in Hull market on August 12th. The only difficulty opposed to this assumption was the length of time which had elapsed between the removal of the diseased Russian cattle from the 'Joseph Soames' on July 29th, and the purchase of the three animals by Mr. Taylor in Hull market on August 12th. This difficulty would of course have ceased to exist if the disease were discovered to have broken out among cows in the dairies of the town of Hull, because the presence of infected cattle in the market a fortnight after communication of infection from the Russian beasts, would have been easily explained. But the most careful inquiry failed to afford any reasonable ground for the conclusion that an outbreak of cattle plague had occurred in Hull.

While the investigation at Hull was being carried on, an outbreak of cattle plague was reported from Patrington, about 15 miles east of Hull. I immediately proceeded to the spot and obtained evidence, which, added to that collected by Mr. Shorten, in reference to the destination of cattle sold in Hull market on July 29th, August 5th, and August 12th, enabled me to construct a consistent theory of the introduction of cattle plague into the three districts of Patrington, Bridlington, and Pocklington.

In commencing this account it is necessary to assume that the virus of cattle plague was in some manner conveyed to animals in Hull market on July the 29th from the Russian beasts which were removed from the 'Joseph Soames' on July the 27th. With this assumption, the introduction of the disease into the three districts referred to, becomes easily explicable. On July the 29th, in Hull market, Mr. Taylor of Bridlington, bought four heifers, and Mr. Newcombe, butcher, of Patrington, bought one heifer and one steer, all of which animals it was subsequently ascertained, came from farms on which no disease of a contagious character had existed. Mr. Newcombe's beasts were driven to the Hull railway station and trucked to Patrington. They were then driven to a field near Mr. Sanderson's mill, where they remained until August the 11th. On that day the heifer was observed to be ill, and on the following day it was slaughtered, and sent to Hull market to be sold for human food. On August the 19th, the steer was observed to be ill and was slaughtered, and on the following day also sent to Hull market. These two animals were seen by the veterinary surgeon at Patrington, and he expressed to me his opinion that they were the subjects of cattle plague, although at the time he did not consider it necessary to make any report of the occurrence as both the animals were killed immediately on the symptoms of disease being observed. In the pastures adjacent to Mr. Newcombe's field, Mr. Sanderson, miller, had two cows and three calves. Another calf on the same premises was kept in a shed some distance from the field. About August the 23rd, three days after the slaughter of Mr. Newcombe's steer, one of the calves belonging to Mr. Sanderson was taken ill and died in two days. A few days afterwards the other two calves fell ill and died; all the carcases were sent to the tanners at Hedon. On Saturday, September the 7th, the two cows were taken ill and died, one on September the 10th, and the other on September the 11th. The last animal was seen and examined post-mortem by Mr. Douthwaite, the inspector at Beverley, and was by him ascertained to have been affected with cattle plague. On September the 19th, I visited Patrington and inspected two cows and a heifer which were in a field belonging to Mr. John Alvin, adjoining that in which Sanderson's cattle were kept. One of the cows belonging to Mr. Alvin I found to be suffering from cattle plague, and from the symptoms which were then apparent, I concluded that the disease had been developed for at least a period of three days. The diseased animal and two healthy ones which were in the same field with it, were immediately slaughtered and buried by order of the local authority. On further inquiry, I ascertained that a cow belonging to Mr. Suddiby, and another belonging to Mr. Watson, had been removed from adjacent pastures a short time previously, and also that Mr. Alvin had taken away two heifers to premises a quarter of a mile distant for the purpose of keeping them there until they had calved. These animals, with the two calves, were slaughtered and buried by order of the local authority.

This evidence was sufficient to prove the existence of cattle plague as far back as September the 7th, when Mr. Sanderson's two cows were attacked, one of these animals having been undoubtedly affected with the disease when it was examined by Mr. Douthwaite; but the fair presumption is, that the outbreak of cattle plague on Mr. Sanderson's farm occurred shortly after the death of Mr. Newcombe's steer on August the 20th; and further, that the illness of these last-named animals was due to cattle plague which they must have in some way contracted during the time that they stood in Hull market on July the 29th. Owing to the paucity of stock in the Patrington district, the outbreak of cattle plague ceased with the destruction of the cattle belonging to Messrs. Alvin, Suddiby, and Watson.

It has been already stated that on the same day, July the 29th, when Mr. Newcombe bought the cattle in Hull market which introduced cattle plague into the Patrington district, Mr. Taylor purchased the four heifers to which the outbreak of cattle plague at Bridlington may be fairly referred. These animals remained all night at Hull after Mr. Taylor had bought them, and on the following day, July the 30th, they were driven to Bridlington, and placed in a field adjoining his house, along with some other stock. On the 8th of August three of the heifers were sold to a butcher at Bridlington, and were killed on the 9th. The remaining animal was kept until the 16th of the month, and then sold to Mr. Woodcock, butcher, at Bridlington Quay. Mr. Taylor asserts that he had no suspicion of the existence of cattle plague among his stock at this time, but he seems to have been under the impression that some of the animals were affected with pleuro-pneumonia, and in consequence of the presence of this disease he was induced to get rid of them to the butcher.

The following evidence in reference to Mr. Taylor's stock was obtained during the investigation that was carried on at Bridlington :—

Adjoining the field in which the heifers purchased at Hull on July 29th were put, was a shed in which Mr. Taylor's short-horn heifer and short-horn bull were kept. The heifer was a pure bred animal, had been shown at various agricultural shows throughout the country, and had taken six first prizes. It is therefore reasonable to conclude that Mr. Taylor had no intention of selling the animal for the purpose of slaughter. On the 26th of August, 10 days after the last of the four beasts bought at Hull was sent to the butcher, the heifer was observed to be unwell; and on the 28th, Mr. Taylor, anticipating, as he states, the presence of lung disease, sold this animal to a butcher at Bridlington, by whom it is believed it was slaughtered immediately. On the 2nd of September the bull which was kept in the same shed, which was partly divided by a wall, was attacked with illness, and within 48 hours this animal died, on Wednesday, September the 4th. It has already been stated that two cows which were sent to this animal on August the 31st were attacked with cattle plague in the course of eight days afterwards.

The evidence of the introduction of cattle plague among Mr. Taylor's stock by the agency of the four heifers which he purchased in Hull market on July the 29th is obviously not conclusive; but it is a reasonable assumption, based on the history of the outbreak at Patrington, that plague-infected animals stood in Hull market on that day, and it is a matter of fact that two lots of cattle which stood in that market were taken to premises on which cattle plague subsequently appeared. It is not known that either of the four heifers which Mr. Taylor purchased on July the 29th were afflicted with any illness while they were in his possession; but it is known that they were all slaughtered, and that a serious disease appeared among his own stock about that time. In the case of Mr. Newcombe, it is in evidence that the animals were attacked with illness which rendered their immediate slaughter expedient, in one case eleven days, and in the other nineteen days after their arrival at Patrington. Assuming that only one of these animals was infected with cattle plague when Mr. Newcombe purchased it, it is easy to understand that symptoms likely to attract attention might not be manifested until the expiration of nine or ten days from the time of its infection. The communication of the infection to the other animal may very well be dated back to the time when the first one manifested signs of the disease.

The extension of the cattle plague to Pocklington district was clearly the result of the sending of cattle which had been on Mr. Taylor's premises to Hunmanby market. There can be no reasonable doubt that the disease did exist on Mr. Taylor's premises prior to August the 19th, and it is a matter of fact that cattle which had been on his premises for some time were sent to that market along with others which had come from a farm where no disease existed, and that these animals were purchased by Mr. Berryman, taken to Pocklington, and lastly to Yapham, where they remained until the cattle plague appeared among them, about a week afterwards, one of the animals (known by the scissor mark) which had been sent from Mr. Taylor's farm being among the first attacked. It fortunately happened that all the cattle which were sold at Hull market on July the 29th, excepting those bought by Mr. Taylor, were sold to butchers, the majority of whom resided in Hull. It is therefore not necessary to pursue the inquiry in respect of the destination of the animals sold in the market on that day any further.

From Mr. Taylor's premises the disease spread by direct contact with a diseased animal to two farms in the neighbourhood. On the 31st of August, two days before the bull was discovered to be ill, Mr. Robinson, of Sewerby, and the steward of the Rev. Yarborough Lloyd Graeme, Sewerby House, each sent a cow to Mr. Taylor's bull. In the case of Mr. Robinson's cow, the animal, which was herded with seven cows and two calves, was seen to be unwell on Friday, September the 6th, and was accordingly at once removed from the pasture, and placed in a shed. On Sunday morning the animal was turned out for an hour in a field in which four yearlings were grazing. All these animals escaped the infection notwithstanding that when I saw the cow on Monday, September the 9th, all the symptoms of cattle plague were well marked.

The cow belonging to the Rev. Y. L. Graeme was seen by me also on September the 9th, and was found to be affected with the disease. This animal at the time it was taken ill was herded with six cows and four calves. Between twenty and thirty cattle which were on the same farm need not be further referred to, as they were in a pasture so remote from that in which the cow was placed as to remove them from all risk of direct infection. The disease on the Rev. Mr. Graeme's farm extended first to the calves, some of which had received the milk of the cow first attacked, up to the time that she was taken ill. On September the 11th the first calf was found to be suffering from the disease. This animal was slaughtered and buried immediately, together with one which had been herded with it. On September the 14th another calf was attacked, and was slaughtered and buried, together with one which had been herded with it. On September the 19th the disease extended to the cows, one animal together with a calf gave evidence of being affected, and they were accordingly killed and buried. On September the 23rd, in order to arrest the further progress of the infection, all animals which had either been herded with diseased ones or had been within probable reach of infection were slaughtered and buried. The animals thus disposed of included four cows, three steers, and one heifer. The remainder of Mr. Graeme's stock, which were kept at a distance, altogether escaped the disease.

The sudden cessation of the cattle plague on Mr. Robinson's farm after the slaughter of the one diseased cow was an unusual circumstance, although not an unprecedented one. It happened on many occasions during the progress of the cattle plague from 1865 to 1867, that the immediate separation of the diseased from the healthy was attended with the arrestation of the plague; and the matter would hardly have been a subject for comment if Mr. Robinson, when he had removed the sick cow from the rest of the herd, had kept the animal properly isolated, instead of which he placed her, while suffering from the disease, which must at that time have been well developed, in the pasture which contained the four yearlings previously referred to. The escape of these animals can only be explained on the assumption that the cow had remained, during the short time she was in the field, in a corner by herself, a very probable thing to occur under the circumstances, and that consequently there was no contact between the sick animal and the healthy ones.

Another outbreak of cattle plague had occurred previously to my arrival, among cattle belonging to Mr. Gibson. On September the 8th I inspected the herd of fifteen animals, and found the majority of them suffering from the plague, some of them having the disease in its last stage. I ascertained that these animals had been placed in the pasture, Colonel Prickett's field, in which they were when I saw them, on the previous Sunday, September the 1st. One heifer of the herd, which then numbered sixteen, was ill. This animal died on the following Tuesday, and was buried in the field. It is not known whether at that time others of the herd presented symptoms of illness, but it can scarcely be doubted that the infection had already made some progress, as the majority of the herd were affected by the end of the week. Mr. Gibson's cattle had previously to September the 1st been pastured in a field at Bridlington Quay, and any communication between these cattle and the diseased beasts on Mr. Taylor's farm must necessarily have been indirect. On September the 9th the remaining fifteen cattle belonging to Mr. Gibson were slaughtered and buried in the field.

On September the 12th I inspected six cows belonging to Mrs. Edmonds, and found one of the animals suffering severely from cattle plague. This animal was immediately shot. No difficulty attended the tracing of the origin of this outbreak, as the cows had been pastured in a field adjoining that in which Mr. Gibson's animals were put on Sunday, September the 1st. No further steps were taken in reference to the remainder of Mrs. Edmonds's cows until the occurrence of another case of cattle plague among them on September the 17th, when it was decided to slaughter and bury all the animals in the field.

On September the 17th, exactly eight days after the destruction of Mr. Gibson's herd, the disease was found to have extended to a herd in another field adjoining that in which his cattle had stood. One cow, belonging to Mr. Franks, was seen by me on that day suffering from cattle plague in a well developed form. The animal when first observed was standing in a part of the pasture remote from the other six cows with which it had been herded. The sick beast was immediately killed and buried. The remaining animals altogether escaped.

On September the 26th a beast belonging to Mr. Frost was found dead of cattle plague in a field at Bridlington Quay, near to the one in which Mr. Gibson's cows had been pastured previously to their removal on September the 1st, on which day some of them were certainly infected with cattle plague. The date of the origin of the disease among Mr. Frost's stock is quite uncertain. As no notice was given of the existence of any malady among them, it is not known whether or not the owner of the animals had disposed of other infected animals previously to the discovery of the one which had died of the disease. Four cattle which were in the field with the dead beast were immediately slaughtered, and the rest of Mr. Frost's healthy stock was disposed of, for slaughter, with as little delay as possible.

The last case of cattle plague which occurred at Bridlington was that of a cow belonging to Mr. Rodgers. The animal was pastured in a field by itself, next but one to that in which Frost's animals had stood. This cow was slaughtered on September the 29th.

In the Pocklington district, where the cattle population is very numerous, great apprehension was, from the first, entertained of the spread of the disease from Mr. Berryman's herd, notwithstanding the precautions that had been taken, immediately on the discovery of the nature of the malady, to isolate all the animals which had been within reach of the infection. Events which subsequently transpired proved that the infection had already been communicated to animals which were placed in the vicinity of Mr. Berryman's herd before the nature of the disease was ascertained. In several instances the infection appeared to have passed over the animals in the fields immediately adjacent to Mr. Berryman's, and attacked others in the next meadow, and in one case an outbreak occurred at a distance of nearly a mile from the original centre of the infection. It must, however, be noticed that, during the time Mr. Berryman's cattle were ill, and before the character of the disease was known, persons in the neighbourhood had been in the habit of visiting the sick animals from curiosity. It is possible that in this way the infection may have been carried to healthy stock at various points in the district.

The first outbreak which was discovered occurred on premises belonging to Mr. Fenteman. One cow, which had, up to September the 5th, been kept in a shed close to Mr. Berryman's fields, and which was removed on that day to a meadow about a quarter of a mile distant, was found to be affected with cattle plague, and was immediately shot and buried.

On September the 14th the disease appeared in a herd of seven cattle belonging to Mr. Kirby. These animals were pastured in a field, separated from Mr. Berryman's herd by two pastures, in one of which sheep, and in the other cattle were grazing. On September the 14th two of Mr. Kirby's beasts were found to be affected with cattle plague, and the whole herd was consequently destroyed and buried.

Animals belonging to Mr. Craddock were next found to be affected, in a field distant about a mile from Mr. Berryman's land. The herd consisted of one cow and three calves. The cow presented distinct evidence of cattle plague when seen by the inspector on September the 16th, and was immediately slaughtered and buried, together with the three others which were herded with her.

On the 30th of September cattle plague was discovered in a herd of fifteen animals belonging to Mr. Towse. These cattle were pastured in a field which was separated from Mr. Berryman's by a small stream. At the time of the discovery of the disease, three animals were found to be suffering from cattle plague, but it was ascertained that one had died on the night of Wednesday the 17th, in all probability from the same disease. This would bring the date of the infection in Mr. Towse's herd back to the time when Mr. Berryman's animals were slaughtered and buried. All the cattle belonging to Mr. Towse which had been in contact with the diseased beasts were immediately slaughtered and buried.

As far as could be ascertained at this time, no other animals in the district had been within the reach of the infection, and it was anticipated that the slaughter and burial of the animals belonged to Messrs. Kirby, Towse, and Craddock, would have the effect of arresting the progress of the disease. On the 22nd of September, however, another outbreak was discovered to have taken place in a large herd of cattle belonging to Mr. Fawcett of Low Belthorpe. The animals, 40 in number, were pastured in two fields within the infected district. One pasture was near Mr. Berryman's fields, the second was separated from the first by a piece of ploughed land. Twenty cattle were pastured in each field. On the day of the detection of the disease it was ascertained that Mr. Fawcett had already lost three animals; one beast having died on the 14th, and two on the 15th of September. These three animals were buried by the owner, who did not at the time, give any notice of the outbreak of disease on his premises. Several of Mr. Fawcett's herd in both fields were found to be suffering from cattle plague; and two animals died before arrangements could be made for the slaughter and burial of the herd. Assuming, what can scarcely be questioned, that the three cattle which died before the disease was detected on Mr. Fawcett's premises were the subjects of cattle plague, it may be fairly concluded that the infection had extended to his herd about the time that the disease was officially declared to exist amongst Mr. Berryman's cattle.

Owing to the discovery of the presence of cattle plague on Mr. Fawcett's premises, it was considered necessary that further inquiry should be made in reference to the sanitary state of the animals in the district, and accordingly Mr. Cope, one of the inspectors in the Veterinary Department, was instructed to proceed to Pocklington, and carry on the necessary investigation. Mr. Cope remained in the district until the disease was exterminated, and subsequently made an inspection of the three districts of Patrington, Bridlington, and Pocklington, in order to ascertain if the necessary precautions had been taken to prevent a recurrence of the malady when fresh stock should be introduced into the infected premises. During his presence at Pocklington Mr. Cope reported the particulars of the following outbreaks:—

On October the 1st a case of cattle plague occurred on Mrs. Beilby's premises at Fangfoss, distant about a mile and a half from the scene of the original outbreak. It appears that on the discovery being made that some of Mr. Berryman's animals had died in the beck which runs along one side of his fields, the inspector of police advised all the owners of stock, for several miles along the course of the stream, to take away their animals. Thereupon Mrs. Beilby took her four cows to her own premises, and placed them in a shed adjoining the house immediately outside the original infected district. This occurred on the 24th of September. On the 1st of October Mrs. Beilby reported to the veterinary inspector that one of her cows was ill, and after making an examination, the inspector decided that the animal was suffering from cattle plague. On the following day the diseased beast and the three which had been herded with it were slaughtered and buried, and the usual precautions taken to prevent the spread of the disease. This outbreak necessitated the declaration of another infected district. On further inquiry it was ascertained that Mrs. Beilby's cows had been pastured in a field next but one to that in which the diseased animals belonging to Mr. Fawcett had been kept.

On the 10th of October, Mr. Burnley, of Garrowby Lodge, about two miles from Mr. Fawcett's farm, at Low Belthorpe, and about the same distance from Mrs. Beilby, of Fangfoss, where the last outbreak occurred, observed one of his cattle showing signs of illness, and accordingly sent for the veterinary inspector. At that time, symptoms of cattle plague were not well marked. On the following day, another animal was taken ill, and, on the next day a third showed indications of the disease, while in the first case the evidence of cattle plague was sufficiently clear. Mr. Burnley's herd, consisting of 10 animals, including the three diseased ones, which had been all herded together, were slaughtered and buried under the direction of the inspector. It is worthy of remark that Mr. Burnley was one of those who adopted the suggestion which I made on the occasion of my first visit to Pocklington, on September the 7th, he had divided his stock into three different lots. Owing to this measure having been taken in time, 16 animals entirely escaped the disease.

The origin of the outbreak among Mr. Burnley's herds could not be ascertained. The animals had been kept in a shed close to the house, and none of the attendants, as far as could be discovered, had been in contact with any animal infected with cattle plague; on this point, however, the testimony of interested persons cannot be received without reservation.

On October the 14th, the veterinary inspector received information from Mrs. Dale, of Skirpenbeck, distant three miles from Garrowby Lodge, where the last animals were attacked, that one of her cows had died on the previous night. On making an inspection, Mr. Jebson found a calf on the premises affected with the disease in an advanced stage, and further ascertained that a calf had died on the same premises about eight days previously. Mrs. Dale did not suspect the existence of cattle plague among her animals, as the last case had occurred on premises not less than three miles distant. The inspector further ascertained that two cattle of a herd of eight, which were in adjoining premises, were affected with cattle plague in the early stage. All these animals were immediately slaughtered and buried. The origin of this outbreak, like that of the previous one on Mr. Burnley's premises, could not be satisfactorily determined. Another infected district had at this time to be declared. The new outbreak was within one mile of the North Riding of Yorkshire, and there was some ground for the fear which existed that the disease might cross the boundary.

On the same day, October the 14th, that the disease was detected on Mrs. Dale's premises, another outbreak was discovered on premises belonging to Mr. Johnson, of Fangfoss, a few hundred yards from the premises of Mrs. Beilby, where four diseased animals had been slaughtered on October the 1st. Mr. Johnson's herd consisted of 10 animals, one of which, a calf, was suffering from the disease in its last stage. This animal, and the other cattle with which it had been herded, were slaughtered and buried.

On October the 18th, cattle plague was detected on premises belonging to Mr. Banks, of Grange Farm, Bishop Wilton. The herd consisted of 23 animals; 19 of which, namely, 8 calves and 11 cows, were kept in sheds, the remaining 4 animals were in a pasture close to the farm buildings. Mr. Banks reported one of the four animals in the field to be unwell on October the 18th, and the veterinary inspector ascertained that this animal was suffering from cattle plague. The four cattle were consequently killed and buried. The animals that were kept in the sheds, not having been in contact with the four among which the disease appeared, were not slaughtered. However, on the seventh day after the burial of the four cattle, the disease appeared among the calves which were kept in the shed next to that in which the cows were kept. Two of the calves gave unmistakeable evidence of being affected with cattle plague, and others showed indications of the disease. Consequently the whole of the animals, cows and calves, 19 in number, were slaughtered and buried by order of the local authority. Nineteen other animals belonging to Mr. Banks, which were pastured in a field next to that in which the first animal became infected, altogether escaped the disease. No other outbreak occurred in the district, and at the expiration of a month after the slaughter of Mr. Banks's herd, a final inspection was made of the three districts in which the disease had appeared by Mr. Cope, who reported that the necessary measures had been taken to prevent a recurrence of cattle plague, by cleansing and disinfecting the premises in which diseased animals had stood, and the fields in which they had been grazing, by the free use of lime, and other disinfecting agents.

The Patrington District, where the disease was discovered on the 12th of September, was declared free on the 26th of October.

The Bridlington District, where the disease was first declared to exist on September the 8th, was declared free by the local authority on the 2nd of November.

The Pocklington District, where the disease was recognised on the 4th of September, was declared free by the local authority on the 25th of November.

In the districts of Patrington and Bridlington fresh stock had been introduced into premises where the disease had previously existed. These animals were seen by Mr. Cope during his final inspection some time after these two districts had been declared free, and were found to be perfectly healthy. This circumstance was satisfactory, as it indicated that the measures which had been taken to disinfect the premises had been effectual.

During the recent investigation of the disease in Yorkshire it was commonly remarked that the infection spread very slowly among the animals which had been exposed to it; that in many cases the period of incubation was unusually long, and that only in one or two instances did the disease manifest an excessive virulence. The apparent peculiarities, however, were referable to the conditions which obtained during the time that the disease existed. In the former outbreak in 1865 precautionary measures were at first generally neglected; animals were allowed to remain together in masses, and were subjected to various forms of medical treatment. Under these circumstances the infection spread with rapidity, and the diseased animals being allowed to live, the affection was permitted to manifest itself in its most virulent form.

In various parts of the country, however, where animals were pastured in the open air, instead of being confined in a shed, it was observed that the virulent type of the malady was considerably modified. The period of incubation appeared to be considerably prolonged, and cattle resisted the effects of the disease for a long time before they succumbed. In the last outbreak in Yorkshire all the conditions were opposed to the rapid progress of the disease. As soon as its true character was ascertained, animals affected with illness of any kind became subjects of suspicion, and isolation was carefully enforced. When cattle-plague appeared in a herd, the sick animals and those herded with them were generally slaughtered and buried, and in the few instances where these measures were not adopted the affected animals were at once removed from contact with the healthy. This precaution, in two instances, secured the safety of the rest of the herd; but in other parts of the same district, in which the same course was adopted, disease extended to the other animals, and it ultimately became necessary to destroy the whole of them.

It is further to be remarked, in reference to the apparent extension of the period of incubation when animals are placed under favourable sanitary conditions, that the date of discovery of the indications of disease is by no means to be accepted as the time of their appearance. It occurred to me on several occasions to examine animals which gave positive evidence of being affected with cattle-plague in the third or fourth day of its progress, notwithstanding that these animals, according to the statement of the owner or the attendants, had remained apparently healthy up to the evening before the day of my inspection. There can be no question that in all these cases a professional examiner would have observed positive symptoms of the presence of the disease some days before it was actually detected. The facts referred to, namely, the perfectly sanitary condition of the districts in which the cattle-plague occurred, the immediate isolation of sick animals, and general adoption of the system of slaughter both of the sick and of the healthy which had been herded together, sufficiently account for the absence of any extreme virulence in the type of the malady, for its slow progress, and the apparent extension of the period of incubation. In the two or three instances in which the disease was concealed, or when it was not recognised for some time after its appearance in the herd, it was found to spread with its usual rapidity, and to present characteristic indications of malignancy.

Notwithstanding the experience which was gained in the districts recently infected with cattle-plague during the outbreak of 1865–7, there was considerable opposition on the part of the owners of cattle to the adoption of the stamping-out system. It was commonly pleaded that compensation very imperfectly represented the loss which the owner would sustain, inasmuch as it would be impossible for him to obtain fresh stock immediately, and his pastures would be useless, or, it might be, his trade as a dairyman would be interrupted for a considerable time. The obvious retort, that these things would happen equally if the animals were allowed to live and become infected one after the other, and to die of disease or be slaughtered, evidently failed to carry conviction, and it may be stated that, with few exceptions, if the owners of infected herds had been allowed to act in consonance with their own wishes and opinions, the animals would have been kept until the extension of the disease among them had made it evident that they had slight chance of escaping destruction.

The two instances recorded in which animals that had been herded with diseased ones ultimately escaped the infection will, doubtless, be added to the evidence of a similar kind which was obtained during the former outbreak in 1865–7, and tend to keep up the idea which exists among a small section of the public, that the stamping-out system is wasteful and unnecessary.

The employment of remedies for the cure of cattle-plague has always been most strenuously advocated by persons who, from their position and experience, must necessarily be entirely ignorant of the whole subject. The stamping-out system is the final resort of all who have carefully investigated the matter, and who have satisfied themselves by observation of the danger which results under ordinary circumstances from keeping animals infected with the disease alive in order to test the effect of medicinal appliances. Our own experience in 1865–7, the experience of Holland during the same outbreak, and the recent experience of France, combine to demonstrate the fact, notwithstanding the apparent success which has attended various kinds of treatment (often the most opposite), that the disease spreads invariably with a rapidity proportioned to the extent to which these experiments are carried on; while, on the other hand, the experience of Prussia is altogether in favour of the system of slaughtering, not only the diseased animals, but those which have been either herded with them, or are placed within reach of infection.

The outbreak of 1872 did not add anything to our previous experience in reference to the efficacy of the means which have always been found effectual in Prussia, but it strengthened the conclusion which had previously been arrived at in reference to the desirability of amending certain clauses of "The Contagious Diseases (Animals) Act, 1869," so as to give to the authorities power to deal with the animals in the immediate neighbourhood of the centres of disease.

On my arrival at Pocklington shortly after the outbreak among Mr. Berryman's herd was discovered, I made inquiries which convinced me that there was every probability of the spreading of the affection through the medium of animals which were in the vicinity of Mr. Berryman's fields; and I have no doubt that, had the inspectors of the several districts where cattle-plague appeared been armed with the necessary authority to enable them to deal with all the instances in which the risk of infection had been incurred, the cattle-plague would have been extinguished almost as soon as its existence was discovered.

Respecting the means which should be adopted in any future outbreak of the malady I have nothing to suggest beyond the adoption of the Prussian system of isolation and slaughter in its entirety. Immediately on the discovery of an outbreak the diseased animals, and those herded with them, should be slaughtered and buried, and all animals in the meadows immediately contiguous to those in which the disease broke out should either be slaughtered or confined in such a position that they may be constantly under the supervision of the veterinary inspectors. For some distance around the infected area it is very desirable that the large herds should, as far as possible, be divided into small lots, in order that the occurrence of a single case of the disease at a distance may not absolutely necessitate the destruction of a larger number of animals than necessary.

Isolation of sick animals directly that any signs of illness, no matter of what kind, are detected, is an obvious precaution which should never be neglected; and an efficient method of disinfection should be constantly used for the persons, instruments, and fodder, and, indeed, all other substances employed about diseased animals. Before fresh stock is introduced into infected premises a complete process of disinfection should be carried out. Everything which is capable of being thoroughly washed should be so treated in the first instance, and some antiseptic agent, such as chloride of lime, chloralum, carbolic acid, or sulphurous acid, should be afterwards applied. Pastures should be left vacant as long as may be convenient. If the fields be well top-dressed with quicklime on the expiration of twenty-eight days after the extinction of the disease, experience has proved that stock can be introduced without risk of infection. Promptness in detecting an outbreak of cattle-plague, and applying the necessary measures of suppression, is an important element of success. When any delay occurs in the discovery of the nature of the disease it is very likely to happen that persons, led by curiosity, will make visits to the herd among which the novel malady has appeared. It has been repeatedly proved that the infection may be easily carried on the hands or clothes to a considerable distance; so that by the time the disease is stamped out in one place it may have already appeared in another. Of the indirect conveyance of the virus of cattle-plague to healthy animals by persons or animals there can be no reasonable doubt. Instances of the appearance of the disease in isolated positions where only such means of communication existed have been sufficiently numerous to establish the fact.

The Contagious Diseases (Animals) Act provides that the owners of premises on which cattle-plague has appeared may prevent persons from passing into his premises; the local authority has power to order that dogs shall be kept from roaming, or to insist on their destruction, if the regulations are not complied with; and it is most important that, in localities where cattle-plague exists, the utmost care should be used in carrying out all the directions which have for their object the perfect isolation of diseased or infected animals, and the prevention of the extension of the malady by agencies which may carry the virus in various indirect ways to points far distant from the centres of infection.

Respecting the communication of the infection of cattle-plague from animals which were on board the 'Joseph Soames' on 27th July to animals in the cattle market on 29th July, it has been admitted that the evidence is not perfectly conclusive. Nor was it anticipated that the inquiry would lead to the discovery of the precise channel through which the virus was conveyed.

The facts however, placed in the order of their discovery, seem to point to one conclusion.

First, on 25th, 26th, and 27th July, a number of Russian cattle affected with plague stood on board a vessel which was lying in the Humber dock a short distance from the quay wall, about 200 paces from the cattle market, where fat stock are sold every Monday.

On 29th July, about thirty hours after the diseased Russian beasts were slaughtered and removed from the ship, two lots of English cattle were bought in the market by persons who took them into the two districts of Patrington and Bridlington, in both of which places cattle-plague subsequently appeared on the premises to which the animals were taken.

The only other theory which has been advanced to explain the origin of cattle-plague in Yorkshire, refers the outbreak to the carcases which were washed ashore at various parts of the Lincolnshire and Norfolk coast. But the evidence is altogether opposed to the idea of the disease having arisen in this way. No carcases were stranded near to the places in which cattle-plague appeared, and on those parts of the coast where carcases were thrown up, no outbreak of cattle-plague resulted.

The accidental circumstance of the sale of nearly all the cattle which were exposed in the market on 29th July to Hull butchers for immediate slaughter probably prevented the wide distribution of the affection.

[*To be continued.*]

XX.—*Report on the Exhibition of Live Stock at Hull.* By RICHARD MILWARD, SENIOR STEWARD.

AT last the Annual Meeting of the Royal Agricultural Society has been held in the capital of the East Riding of the county of York, and perhaps some surprise will be expressed that, although the Society has been in existence for thirty-five years, this is the first occasion of its visit to Hull. Many of the Members are, doubtless, aware that, for the purposes of the Annual Exhibition, England is divided into eight districts, each containing four, five, or even more counties. The districts have been slightly changed in the last ten years. On the last occasion of our visit to Yorkshire (that county being then a separate district) there were six towns which competed for the Show, viz. York, Leeds, Hull, Doncaster, Wakefield, and Harrogate. It appeared to the Council that Leeds possessed unusual advantages, and they, therefore, selected that place for the Meeting, with what success is well known. When the Inspection Committee visited Hull in April 1872, they were much pleased with the site which was offered to the Society; they reported this to the Council, who decided by a large majority in favour of Hull over Darlington. The result has proved that the Council made a good selection, as the meeting has been an average success, although the expenses will exceed the receipts by 400*l.* or 500*l.*

The Senior Steward is generally expected to send in a Report of the entire Show of Live Stock. The horse department at Hull took so much of my time and attention that I should have been quite unable to furnish any account of the other animals, had it not been for the great assistance I have received from my colleagues and the Judges.

With regard to Horses, I must say that, although we had several good animals, and a fair competition in many classes, the Show, on the whole, was not so good as we had a right to expect, when we recollect that Hull is in the immediate neighbourhood of the largest horse-breeding country in England. It is said that some of our conditions, and the long time we keep the horses in the Show-yard, operate against our success in this department. With regard to the first of these objections I have no doubt the Council will consider them before the next prize-sheet is arranged; but I fear we cannot lessen the number of days for the Show. The conditions attached by individuals and by local societies to the prizes they offer frequently differ widely from our own, and the Council should now decide whether it is advisable or not to accept any prizes to which conditions are attached. This would involve much alteration in the prize-sheet, and we must not any longer be restricted to giving prizes only for breeding animals, and especially with regard to horses, the scarcity being everywhere admitted. We should travel out of our old track, and offer prizes for all useful sorts; and although at first we might not have much competition in some of the new classes, we should, by degrees, induce farmers to pay more attention to what has become a very profitable part of their business. When fair, useful cart-horses are worth from 70*l.* to 130*l.* each (to say nothing of entire horses, some of which were sold in the Show-yard for 500*l.*, 350*l.*, 240*l.*, and 220*l.*); four-year-old hunters from 150*l.* to 300*l.*; carriage-horses, hacks, and ponies, at proportionately high prices—it is clearly the duty of the Royal Agricultural Society to encourage as much as possible horse-breeding in England. I saw in a dealer's yard at Hull several carriage-horses and hacks, all bred in Germany, with more quality and better action than most English horses. These were chiefly from English mares by English sires; and we should offer some inducement to prevent the best of these going abroad.

There were 275 horses entered, and of these 37 were absent. At Cardiff the entries were 324, and at Wolverhampton 357; so that in number we were far below the two last meetings. The Agricultural and Clydesdale horses mustered well; but the Suffolk, for which 145*l.* was offered in prizes, had only five stallions (in two classes), one brood-mare, and three fillies—about the same number as at Cardiff. In the report last year Mr. Corbet called attention to the small number of Suffolks, and said: "If the classes be continued at Hull, the eastern counties must make a far stronger demonstration for Yorkshire, or people will say the Suffolk are going out of fashion." Hull is not very distant from the eastern counties, the home of Suffolk horses, and it cannot be said that the above hint has had much effect, or more would have been exhibited. Certainly the few which were shown were good specimens.

Mr. Barthropp, of Hacheston, Suffolk; Mr. Swale, of Sandon, Wolverhampton; and Mr. Turnbull, of Cresswell, Northumberland, the Judges of Agricultural Horses, report as follows:—

In compliance with the request of the Council, we beg to submit the following remarks on the agricultural horses on which we had to adjudicate at the recent meeting at Hull; and we consider the Society may be congratulated on the classes being, as a rule, well filled, whilst there is a decided improvement in the soundness of the animals exhibited, there not being more than one or two cases in which the best-looking candidates were prevented by unsoundness from receiving the prizes to which their good looks would have entitled them.

Class 1, *Agricultural Stallions above Two Years old*, contained fourteen very useful horses, the first prize going to Mr. Sharpley's "Le Bon," a very nice level short-legged bay; Mr. Statter's "Young Champion," well known in the prize-ring, being second. "Young Honest Tom," a 4-year-old bay, with grey markings, with a good top, but rather flat ribs, was third; a short-legged brown horse, with good loins, and a good mover, being highly commended and the Reserve Number. There were eighteen 2-year-old stallions in Class 2, nearly half of which have no pretension to Royal honours. The first prize went to a very heavy blue-roan colt, "Young Briton," belonging to Mr. Newman; the second prize to a nice level colt with good action, called "King Tom;" and the third prize to "Brown Prince," a good topped colt, who, if possessed of rather more bone, would have been first. Mr. Colton's "Boxer," a heavy chestnut, whose badly-rubbed mane gave him an unsightly appearance, was highly commended and reserve; a stylish bay colt, "King of the Vale," and "Negro," a rather high black, being commended.

Nine Clydesdale stallions came forward, but as a lot they did not appear so uniform in character as those we have seen at former shows. The first-prize horse "Conqueror," is a smart-looking grey, and a good mover. "The Duke," a very compact brown horse, with rather a plain head, is second; and Mr. Reed's nice-looking "Wellington" third. "Young Lofty," who did not look like his former self, appeared loose in the back, and could not get higher than highly commended and reserve. In Class 4, there were several very good specimens of 2-year-old Clydesdale stallions. The Earl of Strathmore's "Macbeth" has remarkably good thighs, and a good back, and deserves the first prize awarded to him; the Duke of Richmond took second prize with a nice colt, "Duke;" and Mr. Wright's "Sir Roger," is a thick, heavy colt, with a plain head; the Reserve Number went to a smart bay with a grey tail and rather a low back. Class 5, Suffolk stallions: but four out of the six entered put in an appearance. Lieutenant-Colonel Wilson took the first prize now, as he did at Wolverhampton, with "Heir Apparent," when two years old. This horse is quite a first-class specimen of his breed, with a splendid back, a middle denoting an excellent constitution, and capital legs; there is, however, something not quite nice about his head and ears. The second prize went to Mr. Wolton's "Royal Duke," now three years old, a promising colt on short legs; and we exercised our privilege of recommending the third prize to be given to Mr. Byford for his "Volunteer," a showy-looking horse of good quality; whilst "Royal Prince," a former winner, but of not quite the orthodox colour, got highly commended.

But one 2-year-old Suffolk stallion was shown, belonging to Mr. Wolton, at present unnamed: he is a smart colt, but without any special merit; but having long sides and short legs, he will probably grow into a useful horse. In Class 10, for agricultural mares in foal or with foal at foot, ten mares competed; and although there were some good mares shown with their foals, those without foals had decidedly the advantage, and we would suggest to the Council the advisability of having separate classes, as we consider a mare suckling a foal can scarcely compete on her merits with a mare without a foal. Mr. Crow took the first prize, with his chestnut "Flower," a particularly good 3-year-old, being level and active, and having a good constitution; Mr.

Street's "Beauty," a well-formed, active, wide roan, being second; with Mr. Lester's "Royal Duchess," a grand stamp of mare, rather deficient in quality, third. The above three mares are said to be in foal, and a very stylish grey mare with foal at foot, a fine mover, but with a loin rather slack, perhaps from suckling a foal, was highly commended and reserve. Several nice Clydesdale mares were shown in Class 11, Mr. Watson being first, with a short thick-set mare, "Highland Lassie," Mr. Fleming's "Rosie" being second, and a big mare, "Mrs. Muir," third; Lord Strathmore's "Rosie" being highly commended and reserve. Only one of the two Suffolk mares entered were on the ground, viz. Mr. Horace Wolton's "Diamond." She is, however, good enough to hold her own in any company.

Class 16 was the worst class we had before us. The first-prize filly was nicely turned on the top, but was low-hocked and thin in her thighs. The second prize went to rather a nice brown filly from Sussex, and the Reserve Number to a short thick filly with no action. Class 17, *Clydesdale Fillies:* the winner of the first prize is a nice thick active animal. Mr. Fleming's bay, with a white face and three white legs, ran the winner of the first prize very close, and took second honours; whilst Mr. Graham's "Rose of Netherby," the winner of the third prize, is rather too long in the leg. Class 18, *Suffolk Fillies:* Mr. Wilson took first and second prizes; the first a very smart one, with beautiful quality, good legs and feet, and a good mover; the second is rather dark in colour, with a want of pure Suffolk character about her. The other filly shown was a very good one in appearance, and we regretted we could not place her first. There were four pairs of agricultural draught-horses shown, Mr. Brierley taking the prize with two wonderfully good geldings, "Champion" and "Tommy Dodd;" they looked, however, better suited for the drays of Hull than for ploughing and harrowing on clay land, which they were certified to have done. That wonderful mare, "Sensation," delighted and astonished the spectators, and we regretted she had not a partner more worthy of her than "Warwick;" Mr. Marshall's chestnut mares were a good match, and looked active and useful. We commended the entire class.

There was a fair show of thoroughbred stallions—"Dalesman" by far the best. Mr. Chaplin is fortunate in possessing two such horses as "Dalesman" and "Snowstorm." His tenants and neighbours are also fortunate in being able to use such horses at a moderate charge. Three very good foals by "Snowstorm" were with their dams, Nos. 126, 141, and 143. The hackney stallions were about as good a lot as is generally shown, but unless they are put to thoroughbred mares, I have little faith in the produce being hacks such as I should like to ride: an impartial examination of the so-called hacks in Class 25 will explain my meaning. The above remarks will apply to pony stallions. There were only five shown, and they were nothing extraordinary. "Sir George," the winner of the first prize, had not good shoulders, and "Mischief" had not enough action. The reserve number was given to No. 86, "Robbie Burns," a pony with good action, but common hind-quarters. The hunting brood mares were exceedingly good; the hackney mares only moderate; and the pony mares still worse. The first-prize winner had good action and some other good points, but her shoulders would not bear inspection.

The hunters in Class 21, five years old and upwards, were a very respectable class; and here I may say I agree with all the decisions of the Judges, except in this class. I could not have placed "Joe Bennett" and "Spellahoe" before "The Banker" and "Gamester;" but as two of the Judges rode them, I may be wrong in my opinion. I rode "The Banker," and liked him.* The 4-year-old hunters, in Class 22, cut a good figure. Several of them had been winners in former years, and at other Shows. There was not quite a first-class horse amongst the nineteen, but several which nearly approached that character. Class 23, for 3-year-old hunters, was very fair as to number (sixteen), and also as to merit. The first prize was awarded to "Novelty," No. 227. An objection was made as to his age, and the Veterinary Inspectors reported "that from the state of his dentition they were of opinion that he was four years old." In consequence of this opinion, the prize-card was removed from No. 227, which brought up "Showman," No. 220, to the top, and "Cornishman," No. 231, obtained the second prize. Both these are very fine young horses. The latter was first in his class at the Gainsborough Show last week.

The owner of "Novelty" is not satisfied, and produces a certificate from the breeder, stating the horse is only three years old, but he admits that teeth have been removed—for what purpose is well known. The Council will decide whether, under these circumstances, the horse should be disqualified. Admitting that the breeder's certificate is correct, which I have no reason to doubt, it still remains to be decided whether, as the horse was entered "breeder unknown," any breeder's certificate can be recognised by the Council.

Only eight 2-year-old hunters appeared in Class 24; of these several were very good. No. 238, the winner of the first prize, excellent, but not a good colour.

Class 25 was very strong in numbers, but very few of them were hacks, if I understand the meaning of the term. Many of them had good action, but they appeared far more suitable for harness. Of course I do not include "Ozone," which is a thorough gentleman's hack.

The following is the report of Colonel Luttrell, one of the Judges, written for himself and colleagues:

Before giving a detailed account of the horses exhibited at Hull I beg to make a few remarks with reference to the condition of three crosses of blood attached to the prizes offered by the Local Committee. All good judges in the present day are fully alive to the importance of selecting animals with plenty of blood. Any condition, therefore, enforcing three crosses, is not only

* Since this was written, the Judges at the Yorkshire Society's Show at Harrogate have placed "The Banker" before "Joe Bennett."

unnecessary but objectionable. Unnecessary, because quality, the true test of blood, is easily detected in half-bred horses; objectionable, because it opens a wide door to the unscrupulous, and offers a great temptation to the manufacturers of pedigree—a trade not unknown in the horse line—and debars numbers from exhibiting, who, possessing first-class animals with plenty of quality, purchased either of dealers or at fairs, are unable to trace a pedigree and too honest to revert to the manufacturing process ; besides, it must lead to endless protests, which generally are, to say the least of them, vexatious for a Society to deal with. I think, therefore, it would be well to omit these restrictive conditions, and leave the question of quality to the discretion of the Judges. I will take the classes as they came before us.

CLASS 7. *Thoroughbred Stallions for Hunters.*—11 entries. This would have been a very good class for most counties, but nothing grand for Yorkshire. No. 67, "Dalesman," was *facile princeps.* He certainly looked better than I had ever seen him; plenty of work and the Lincolnshire air have worked wonders ; few horses are improved by too much flesh, most are spoilt by it ; certainly "Dalesman" looks twice the horse he did when overloaded at Islington last year ; now he is all muscle and wire, which, with his good legs, strong loins and quarters, makes him look all over a hunter fit to carry 14 st. to any hounds ; and yet I should like him better if his shoulders were a little finer; a defect, however, which does not appear to impede his action, as he moves corkily and well. No. 60, "Suffolk," took the second honours, in many respects a very good stamp, and, if you only look at him above his hocks and knees, you would not have much fault to find, except that the points of his shoulders might be improved with the spokeshave.

Major Barlow was third and Reserve Number with "Chaucer" and "Massanissa," between which there was not much to choose. "Chaucer," barring his hocks, shows a good deal of hunting form, whilst "Massanissa" hardly carries bone enough to get weight-carriers. Of those unplaced, "Grand Master" is a very level true-made horse, but with faulty action, and "Carbineer's" straight short shoulders and slack girt quite put him out of the race ; many of the others looked more like harness than hunting.

CLASS 8. *Stallions for getting Hackneys.*—17 entries. A very difficult class to get at. For my part I am as much an advocate for blood on the road as in the field. Now many of the animals exhibited here were totally unfit for hacking to covert, or fiddling up and down the Row ; some had a dash of the Norfolk, with flashy tearing action all over the place,—very sensational, I have no doubt, to the lookers-on, but anything but desirable for a pleasant ride. We were obliged to select those animals that had hacking qualities themselves, and were most likely to transmit good and easy action to their progeny; of these, No. 71, "Lord Stanley," was decidedly the best; he has good shoulders and quarters on excellent legs; he is somewhat deficient in his middle piece, but being only 3 years old, a great improvement will take place on this point; above all, his action is very good all round. No. 78, "Young Lord Derby," a very promising colt, with quality and action, good limbs, and nice shoulders, was placed second. No. 85, "All Fours," is a grand old horse, but his upright joints and stumpy action told the tale of hard work and age. No. 82, the Reserve Number, "Fireaway," an old prize-taker, quite one of the right sort, had to give way to his more youthful and aristocratic competitors.

CLASS 9. *Pony Stallions.*—5 entries. No. 88, "Sir George," altogether a model, but more of a horse than a pony, was easily placed first. Such form and action must do service in improving the breed, if put to pure-bred ponies and not half-bred cobs. No. 89, "Mischief," placed second, was more of a pony than "Sir George," but lacked his action and quality; the others were indifferent.

Class 13. *Hunting Mares.*—14 entries. Quite up to the average. We soon found our first in No. 122, "Lady Derwent," a fine, long, low mare, with plenty of substance and breeding. No. 116, "Old Go-a-head," too well known to comment upon, was a good second, and an old mare, No. 125, "Lady Byron," looking all over like a hunter, was third. No. 118, "Snowflake," a blood-like mare with weak hocks and middling shoulders, got the Reserve Number. There was a rare foal in this class by "Snowstorm," out of a mare of Mr. Chaplin's. No. 117, "Lady Josephine," unmistakably by "Rataplan," with a good foal by "Carbineer," looked likely for breeding hunters.

Class 14. *Hackney Mares.*—13 entries. Not much out of the common; plenty of room for improvement. No. 131, "Jessie," a nicely-turned mare on good short legs, looked like going the pace to covert or carrying a boy to hounds. Nos. 136, 137, placed next, though advanced in years, were quite the right stamp. Another good-looking foal by "Snowstorm" appeared in this class with a mare of Mr. G. F. Howard's.

Class 15. *Pony Mares.*—A short entry of 5. The first prize, No. 146, "Venus," 3 years old, was a good strong short-legged pony with capital action, and rare loins and quarters. No. 148, "Fairy," a light-made, well-bred chestnut, with easy airy action, was second, and No. 149, "Pit-a-Pat," a short cobby wear-and-tear looking animal, the Reserve Number.

Class 21. *Hunters 5 years old and upwards.*—16 entries. Considering the very meagre prizes offered, and the restrictions attached to them, this class was very well represented. No. 188, "Joe Bennett," was decidedly the best, though not without his faults. I should prefer him if he showed less daylight, and more strength in his hocks and second thighs; in other respects he is a nice horse, and without having extraordinary action moves well and in good hunting form. No. 180, "Spellahoe," said to be thoroughbred, a fact of which I can find no record, was second; his neck don't come right out of his shoulders, which makes him carry his head in the air, and gives him the appearance of requiring more than ordinary hands to steer him; however, my brother Judges, who rode him, reported favourably of his going. No. 177, "The Banker," looked more like a hunter, but his pounding action made him unpleasant to ride, which told against him. A brown horse, No. 173, "Gamester," with plain quarters, moved remarkably well, and got a commended card. "Landscape," No. 185, lacks quality, and is by no means a good goer.

Class 22. *Four-year-olds, up to not less than* 14 *st.*, brought 25 entries. Here Nos. 195 and 194, "Marshal MacMahon" and "Honeycomb," had to fight it out again. The "Marshal," though not a first-class goer, is by far the best mover of the two; a good open way suits him better than the London tan; he has not advanced so much on his 3-year-old form as I expected, but he looks better now than he did when overloaded with flesh at Islington. A little more length before the saddle, less slackness over the loins, and more freedom from his shoulders, would greatly improve him to my eye; yet taking him altogether he looks like a gentleman, and will tumble into a nice hunter some of these days. "Honeycomb" is in many respects a fine-looking animal, but he stands away from his hocks, and when he is set in motion seems to ignore them altogether; being a large overgrown baby he may improve; but I prefer more stuff in a smaller compass. Nos. 202 and 211, both by "Laughing Stock," were good movers and showed quality; the latter was light in his hocks, and not quite right about the shoulders. Some of the animals in this class were not up to the required weight; amongst them, No. 203, a bay horse by "Theobald," a very neat blood-like horse and the best mover of the lot.

Class 23. *Three-year-olds.*—20 entries. Contained a great many promising animals. No. 220, "Showman," a level compact colt, with good shoulders, back, and quarters, rather light of bone, was placed first, and next to him, No. 223, "Cornishman," a wiry well-bred looking animal with capital legs and good forehead. I am told he has been lately running rough in Cornwall, and I have no doubt that change of air and better feeding, which he is sure to get in Major Barlow's hands, will turn him into a smart horse. No. 227, "Novelty," was originally placed first in this class, but was disqualified in consequence of being over age. No. 218, "Singleton," is not right about the shoulders, but otherwise has a great many good wearing points. No. 221, "Prizetaker," the winner at Alexandra Park, moves well for a young one, but his hocks and short quarters tell against him.

Class 24. *Two-year-olds.*—10 entries. Nothing out of the common except No. 238, a fine dashing colt by "Theobald," with rare quarters and legs, but one of the worst-coloured animals in the yard; which, if the old saying be true, "A good horse is never a bad colour," won't matter to him in the hunting-field, where I reckon he will, some of these days, show his tail to most of them. No. 236, "Victor," was next in place, who, barring his shoulders, which take too much after his sire, is a good useful-looking animal. No. 240, the reserve No. colt, by "Neptunus," promises well, but he looks more like harness than hunting.

Class 25. *Hackneys.*—A large entry of 28, but the greatest mixture I ever saw together in a hack class—some under-bred cobs, some only fit to draw a tea-cart, and others to carry a butcher's basket. The winner turned up in No. 257, "Ozone," a long, low, well-bred little mare, rather light of bone below the knee, but a nice even goer with good manners and excellent quality. No. 265, "Polly," by "Motley," was placed second. A good mover, but rather coarse about the shoulders. No. 267, "Princess," a useful short-legged mare got the Reserve Number.

There were two protests as to size, neither of which were sustained; one as to age, to which I have alluded, and several as to pedigree. The Stewards have not been able to investigate the whole of these; but will report to the Council in November.

Mules and Donkeys.

The Judges, Professor McBride, of Cirencester, and Mr. Lang, of Bristol, report as follows:—

Asses and Mules.

By the kindness and generosity of Edward Pease, Esq., of Darlington, the Society were enabled to offer most liberal prizes in both classes.

Class 26. *Jackass not under* 13 *hands, for getting Mules for Agricultural Purposes.*—There were only three animals exhibited. The first prize a black (cross between Spanish and French ass), showing great quality and size, with good middle and quarters. The second a grey Spanish (imported), very fair, particularly in shoulders and fore, but wanting in middle. The third ass, a brown Poitou (imported), belonging to Mr. Pease, was entered not for competition, being the best of the three, having capital shoulders, big crest, fair middle and quarters, and wonderful legs and feet, large flat, short in the pastern; he was out of condition. This was a specimen that intending breeders should particularly notice, being of the true type for breeding heavy mules. The height of these asses was about 14 hands.

Class 27. *Mules not under* 15 *hands, for Agricultural Purposes.*—There were seven animals exhibited, all being of fair merit. The first prize, a grey, about 16 hands, was excellent, being large, with capital crest, long shoulders, a thick middle, and very good legs, big and flat, his quarters rather slack, but action perfect. The second, an aged mule, about 16 hands, brown, had good quality, with well-made middle and quarters, but a little light in bone for heavy agricultural work, at which she had evidently been well employed. The third prize, a younger and smaller mule, three years old, brown, showed great style, with the prospect of being, when in her prime (7 years old), a large useful animal; she had fine shoulders and good legs; her action was poor, but owing to rawness more than incapacity. A brown 4-year-old mule, about 16 hands, not for competition, came next in merit to the grey, having capital shoulders, middle and quarters, very big legs and feet; action very good. Though the classes were only moderately filled (as to number), it was a good commencement, and we sincerely hope this useful class of animal, which Mr. Pease and others are so pluckily trying to introduce amongst the agriculturists of England for draught work, will be in time largely bred and widely used, for we consider them in every way suitable for heavy work, where strength, pluck, and endurance are essential points.

It will be recollected that a few years since a suggestion was made at the Council in favour of giving prizes for donkeys and mules. The matter was some time under discussion, and the Council decided by a large majority that such prizes would not be desirable. The exhibition at Hull was under different auspices, as the whole of the prizes, amounting to 100*l.*, were given by Mr. Pease. It is, perhaps, ungracious to say a word against prizes so liberally offered; but the general opinion in the Showyard was not in favour of the practice being continued, and in this I entirely concur. Surely it would be far better to increase our classes for horses than to encourage the breeding of animals of such doubtful value.

Cattle.

With regard to Shorthorns, Mr. Leeds (the Steward of the Cattle Department) informs me that the Old Bulls (Class 28) were good, but that Class 29 was weak, and contained nothing striking. The Bull Calves (Class 31) were fair, but not equal to the same class at some recent meetings of the Society. The classes for Shorthorn females were of superior quality to those of the other sex, and upheld the character of the Show better than the same class did at Wolverhampton in 1871. The Two-year-old Heifers (Class 33) were a very fine class, while the Yearling Heifers (Class 34) formed the great feature of the exhibition of cattle, and equalled those exhibited at any Show of recent years. The Heifer Calves (Class 34) were a good average class, and the first-prize animal was of superior quality.

The Judges collectively have not sent in a Report. Mr. Beauford merely remarks—

It was about an average show of Shorthorns.

Class 30 was a bad class, and the Heifer Classes, as usual, very good.

Mr. Jefferson enters into detail, and says :—

Class 28 contained ten animals of great merit; but, in awarding the prizes, the Judges themselves were not satisfied, whatever the public might think of their decisions. After selecting five we differed as to the order in which they should be placed. We all agreed that No. 288 did not seem useful for breeding purposes; but the Veterinary Inspector took the responsibility off our shoulders by pronouncing in his favour. I think we did not act consistently in withholding commendation in this class. If No. 287 was considered worthy of the fourth prize, Nos. 286, 292, and 293 ought to have had commended tickets.

Class 29.—Here again the Judges were divided. No. 299 does not take the eye at first, but he improves on acquaintance, and he was well worthy of the position assigned to him. No. 307 has beautiful fore-quarters, but a shabby-looking stern. No. 300 is an even made aristocratic-looking bull, and rightly placed third. No. 298 is a great flesh-grower, level made, and richly clad; and, had it not been for his deficiency in neck vein, he might have commanded a better position. Even with this fault, it is a question whether he should not have changed places with No. 307. No. 303 is a majestic even-fleshed animal, of great substance; but his coarse shoulders nearly forfeited for him the slight honour that he won.

Class 30 we considered the weakest we had before us, and again we differed as to the order of merit. Neither Nos. 312 nor 315 came up to my standard as Royal prize winners.

Class 31.—Here, for the first time, the Judges were unanimous. Nos. 336 and 339 are two calves of great promise; and if their education is properly attended to, I expect to see them Senior Wranglers of future Royal examinations.

Class 32.—We had no difficulty in selecting No. 357 for first honour, but we joined issue in placing second and third.

Class 33.—Having chosen Nos. 378 and 371 for first and second prizes, it became an invidious task, amidst so much excellence, to draw for third and fourth; eventually we placed Nos. 375 and 376, two young mothers of offspring, in preference to their more obese and barren-looking rivals.

Class 34 gave rise to much critical argument amongst three Judges, whose individual tastes and fancies seemed to run in different grooves. No. 302 was the rock upon which they split, and the question arose whether she should have first, second, or fourth place assigned to her. The heifer certainly is a wonderful grower; but her excellences are more suggestive of Bingley Hall or Islington honours, than of a prolific mother of Shorthorns.

Class 35 contained two ripe plums, the richness of whose flavour acted alike upon all our palates.

Mr. Mitchell reports as follows :—

The Shorthorn Classes, as a whole, were very good; some of them particularly so.

Class 28. *Old Bulls.*—Was a very fine class all over, the first and second prize ones remarkably so; although we thought the first too much fed up even for a Showyard.

Class 29. *Bulls under Three Years old.*—Not equal to Class 28; still there were some first-rate animals in it.

Class 30. *Bulls under Two Years old.*—The weakest class in the lot.

Class 31. *Bull Calves.*—A good class, some very fine animals in it.

Class 32. *Cows.*—Although small in numbers, remarkably good in quality. Seldom are there six such fine animals in one class.

Class 33. *Heifers under Three Years old.*—A remarkably fine class. We commended the whole class, and difficulty was felt in awarding the prizes.

Class 34. *Heifers under Two Years old.*—Also a very strong class; a great many fine animals in it.

Classes 32, 33, and 34 were the best of all the classes.

Class 35. *Heifer Calves.*—Also a good class.

Class 28 having been collected in the judging ring, one of the Judges, on referring to his book containing the numbers and ages of the animals brought into competition, refused to judge No. 293, on the ground that the age there given him did not agree with the age at which the same bull had been entered last year at the Blackburn Show of the Blackburn and East Lancashire Agricultural Society, at the Lancaster Show of the Royal North Lancashire Agricultural Society, and at the Show of the Keighley Agricultural Society. The bull having been ordered out of the ring, with the reluctant consent of the Stewards, the judging was proceeded with in his absence; but the awards of prizes were not completed by the signature of the Judges being attached until after the Council had had an opportunity of deciding upon the propriety of the course pursued. This opportunity was afforded on the following day; and the Council decided that, before completing their awards, the Judges were bound to reinspect the whole class, and award such distinction or prize to No. 293 as his merits should entitle him to receive. The second judgment did not, however, alter the decisions arrived at on the previous day: and as the whole subject has been referred by the Council to a special Committee, it would be premature to discuss the merits of the case in this Report.

The Judges of Herefords and Devons were Mr. Greenslade, of Romansleigh, South Molton; Mr. Haywood, of Blakemere House, Hereford; and Mr. Hall Keary, of Aldenham, Bridgnorth, who report as follows:—

Although the show of Herefords is not equal on this occasion, either as regards number or quality generally, to what it was both at Cardiff and Wolverhampton, yet, considering the great distance from their native district, we consider the exhibition to be on the whole fairly satisfactory.

Class 36.—No. 442, first prize, and No. 443, second prize; both possess good character and symmetry, with deep flesh; the first-prize animal being remarkable for length and great substance throughout.

Class 37.—In this class only three competed, none in their present state possessing superior merit, although they are all good stock animals.

Class 38.—Seven entered the ring in this class, and, in consequence of their not being up to the usual standard, we had considerable difficulty in satisfying ourselves in making our awards. We consider the prize-takers possess scale with a good character.

Class 39.—This was a very fair class. No. 458, first prize, has great length, good outline, and bloodlike character; whilst No. 464, second prize, has good substance, but is somewhat deficient in touch.

Class 40.—Although short in numbers, the class may be described as a remarkably good one. No. 472, first prize, is a rare specimen, and probably the best of her breed in the yard. No. 471, second prize, is a long grand cow, but is not so evenly covered as the first-prize animal.

Class 41.—Only one heifer exhibited, and that a very good one.

Class 42.—The three prize-takers all possess considerable merit, and the whole class is a very good one.

Class 43.—Although this is a small class, it comprises several animals of superior merit.

Although the competition in the Devon Classes is rather small, the majority of the animals exhibited are excellent specimens of their breed.

Class 44.—No. 491, first prize, is in every respect very superior, with a true Devon character; and No. 492, second prize, is a very massive grand bull. No. 490 was well worthy of a prize, but, in consequence of the short entry, one could not be awarded by the rules of the Society.

Class 45.—Two only exhibited; both good.

Class 46.—Two only exhibited, and both also very good.

Class 47.—This was a good class, with several superior young animals amongst them.

Class 48.—No. 506, first prize, has remarkable substance, with first-class symmetry and quality. No. 504, second prize, is nearly equal to No. 506, in symmetry and quality; but at present does not possess quite so much substance. The remaining two cows are both very useful animals.

Class 49.—The first and second prize heifers are both of superior merit, and the remaining two are both good heifers.

Class 50.—Only three exhibited, all of which are meritorious.

Class 51.—Six calves were exhibited, all of which are extremely attractive and promising animals.

The Judges of Jerseys, Guernseys, Galloways, and Ayrshires were Mr. Gibbons, of Burnfoot, Longtown; Mr. Middleton, of Cuttleslowe, Oxford; and Mr. Tait, of the Prince Consort's Show Farm, Windsor. They have sent the following report:—

We, the Judges of the Channel Islands and Scotch Cattle and other Established Breeds, beg to report that in each of these classes there was at Hull a great falling off in the number of animals exhibited, which, as far as the Channel Island cattle were concerned, may perhaps be accounted for from the fact of Hull being situate at such a great distance from the Southern Counties, where these breeds are mostly bred and cultivated, as also from the ports of landing of the imported Island bred cattle. We failed to see a single exhibitor from the Island. Amongst the Jersey stock, nevertheless, in Class 52 for Jersey Bulls, there were seven exhibited, the whole of them being really good animals, and were all commended; but it appears that the animal which took the first prize in this class took the same prize last year at Cardiff, consequently it seems to us that it is a very questionable policy to allow an animal, after having gained the highest honour known in England—viz. the first prize at the Royal Show—to again compete for the same prize; and our opinion is that the proper and only place for an animal so circumstanced is the stud, there to be kept entirely for breeding purposes, after being reduced to a natural and healthy state, so as to become the sire of healthy future generations, instead of following the practice now so much in fashion and vogue of keeping animals in an unnatural and pampered state for the purposes of show, so as to be at best a doubtful and uncertain getter of weak and unhealthy offspring. As we have said, all the animals in this class were good, consequently it was a task to select the reserve number; but the choice seemed to be between Mrs. Simpson's "Prince Crocus" and Mr. Digby's "Cowboy." The point was decided by the majority in favour of Mr. Digby's Island bred animal. As regards the Jersey prize cows and heifers, the quality—that is, the fineness of breeding of the animals—was very apparent. They were also very symmetrical and bloodlike, and showed also to be great milkers; in point of fact, they one and all exemplified the familiar Latin phrase, "Multum in parvo," and also proved to be a great attraction to the admirers of Alderneys, and more especially to the lady visitors during the Show. The next three classes of Guernseys were poorly represented, and, instead of being a grand lot as at Cardiff last year, they were here only a middling lot for a Showyard. There were in the Galloway classes about enough animals to take the prizes, yet withal they were good animals, and showed like making first-class beef for the consumer. In the three classes of Ayrshires there were only three animals exhibited, viz. two fairish females and a bull. The last three classes we had to adjudicate on were the other established breeds. Now these classes were entirely filled with Norfolk-polled animals and two dandy little Shetlanders. The polls were throughout a good lot of heavy-fleshed animals, with fair pretensions to milk; and, from seeing such good animals coming from a distance, we feel, perhaps, it would not be presumption on our part to suggest whether or not a satisfactory class of Norfolk and Suffolk Polls might not be formed at Bedford next year, as that place would be nearer their homes; for we consider they are breeds which for general usefulness and docility ought to find favour at the Royal Show.

Sheep.

Mr. Ridley, the Steward of Sheep, has sent an admirable report, which requires no addition from me.

It may be said generally of the exhibition of sheep at Hull, that, though none of the classes, with the exception perhaps of the Southdown and Shropshire shearling rams, were very largely represented, there were yet but few of them which did not display a fair average of good sheep, while some, as the report of the Judges will show, comprised sheep of extraordinary merit. And it is satisfactory to be able to state, that while this year's Show compares not unfavourably in those respects with those of former years, it does, as regards honest shearing, evince that the efforts of the Society for the last few years have borne some good fruit. For the inspectors of shearing (who were Mr. H. Bone, of Avon, Ringwood; Mr. R. Brown, of Wigginton House, Tamworth; and Mr. W. Jobson, of Buteland, Bellingham) were this year in a position to report to the Stewards that there were in their opinion no cases in which the sheep had not been "really and fairly shorn bare;" and whereas six entries of Shropshires were disqualified last year, one of the inspectors (and not the least experienced) was able to say that he had never at any of the Royal Shows seen this class of sheep so fairly dealt with. It is idle, however, to pretend that the question has been finally settled, as perhaps it might have been, had not the objections of various breeders obtained a reversal of that decision of the

Council which, after the Plymouth Show, substituted the 1st of May for the 1st of April; and it must be stated, as it has been on former occasions, that the inspectors have, in their anxiety not to do an injustice, given in every case the benefit of any doubt there could be, and have consequently passed, as fairly shorn, some sheep, especially in the Leicester and Cotswold classes, about which they had some considerable doubt.

Taking the various classes in the order in which they appear in the catalogue, the Leicesters came first. There were 53 rams in the two classes (34 shearlings and 19 old sheep), and of these the best was Mr. Thomas Marris's ram, which was in the aged class, and was a sheep of great width and quality; while Mr. G. Turner, jun., and Mr. John Borton, took almost all the rest of the prizes and commendations, both for rams and ewes; Mr. Teasdale H. Hutchinson, of Manor House, Catterick, winning the third prize, and the Reserve Number, with a commendation for the shearling ewes. The Judges were Mr. C. Clarke, of Scopwick, Sleaford; Mr. T. Potter, of Yellowford, Thorverton, Devon; and Mr. W. Sanday, of Radcliffe-on-Trent; and they report:—

The Leicesters of 1873 are inferior to those of previous years.

The first-prize shearling is a neat sheep, rather too small, but has a good neck and hind-quarters, with a very nice fleece, and we think him a very useful sheep.

The second is a useful sheep of good size, but deficient in style.

The third is very likely to grow into a good sheep.

Among the old sheep we think the first-prize a very good one. The second is a very useful sheep, with good fleece. The third, a fine old sheep with a light fleece, a little defective in his carriage and over-fed.

Of the shearling ewes, the first are very neat with well-sprung ribs, good necks and fleeces; a good pen. The second are large and very useful; and of the third the same may be said.

The Cotswold class were not very strongly represented in point either of numbers or of quality; the pens of shearling ewes, especially, being of no very high excellence. As regards the rams, however, both shearling and aged, it cannot be said that they were below the average of the Royal Shows, and in the opinion of many they were a stronger lot than has been shown of late years, with the exception, of course, of Oxford. Mr. Thomas Brown, of Marham Hall Farm, Norfolk, took all three prizes for shearling, and the first two and Reserve Number for aged rams; while Mr. R. Swanwick secured the Reserve Number and a high commendation for his shearling ram, and the third prize for the older sheep. Messrs. H. Aylmer, of West Dereham, Norfolk; Robert Garne, of Aldsworth, Northleach; and R. J. Newton, of Campsfield Farm, Woodstock, judged, and their report is as follows:—

CLASS 73. *Shearling Rams*, had a fair entry as to number. The first-prize sheep, No. 664, was a sheep of good form, of good Cotswold character, and of good general appearance. The second-prize sheep, No. 666, was of good form and good quality of mutton, but rather wanting in size.

CLASS 74 was of fair average merit, but did not contain any animals requiring particular notice.

CLASS 75 contained only 6 entries, and those not up to the usual standard of excellence we have formerly seen at the Royal Shows. In fact, we consider this class very badly represented.

Of Lincolns there were 19 shearling rams, and only 3 older ones, with 5 pens of shearling ewes. And here again, as in the Cotswold, the ewes were inferior in quality to the other two classes, which were, however, of superior excellence. Messrs. W. and H. Dudding took first prize in both the ram classes, with two grand sheep of immense width and substance. Mr. E. J. Howard, of Nocton Rise, was second for shearling rams; and Mr. John Pears, of Mere, third, with a sheep having a little more of the Leicester type; and in the aged sheep the same gentleman took the third prize; while the second fell to Mr. W. F. Marshall, of Branston, Lincoln, whose sheep had no cause to be ashamed of his defeat by the first-prize one, No. 709. The shearling rams were thought so good by the Judges, that they commended the whole class. Messrs. J. H. Casswell, of Laughton, Folkingham; J. Greetham, of Stainfield House, Wragby; and R. J. F. Howard, of Temple Bruer, Lincoln, reported as follows:—

We consider CLASS 76 of *Lincoln Longwool Shearling Rams* to be a very good class both in wool and mutton, and, being large in number, had no hesitation in commending the class.

CLASS 77 was small, but very good.

CLASS 78 is only a moderate class.

It is satisfactory to find an increased number of Border Leicesters coming to the Royal Shows. There were at Hull 19 rams entered, of which only 1 was an absentee, and 5 pens of shearling ewes; so that these useful sheep, now appreciated in other districts beside the Borders, were, comparatively speaking, as well represented as any class in the Show. Mr. Thomas Forster, jun., of Ellingham, Chathill, Northumberland, exhibited three rams, and took, easily, two firsts and a second prize; his sheep, No. 735, being of immense girth and width, and good quality. Mr. Alexander Bell, of Linton, Kelso, took the second prize for shearling rams. Mr. William Purves, of Linton-Burnfoot, Kelso, took the third prize and the Reserve Number with a commendation. The same gentleman was first and second for shearling ewes, in which class Mr. R. Tweedie, of the Forest, Catterick, Yorkshire, obtained the Reserve Number with a level lot of ewes of good quality, but of less size. In the aged rams

Mr. G. Laing, of Wark, Coldstream, was third to Mr. Forster's two sheep, and Mr. R. Tweedie took again the Reserve Number and commendation. The Judges, who were Mr. J. Jardine, of Arkleton, Langholm; Mr. G. Rea, of Middleton House, Alnwick; and Mr. J. Rand, of Bowmont Hill, Coldstream, report:—

Class 79. *Shearling Leicester Rams.*—We were glad to find an increased number of sheep shown in this class, and of fair average quality.

Class 80. The first-prize ram in this class was a very superior animal, and the whole of good quality.

Class 81. The prize sheep of this class were superior, and generally good.

The Oxfordshire Downs numbered 17 entries in the shearling ram class, and 6 in the older sheep, with only 4 pens of shearling ewes; the exhibitors, too, being only seven. But, as the report of the Judges (who were the same as for the Cotswold) will show, all the classes were worthy of honourable mention. Mr. John Treadwell, of Upper Winchendon, Aylesbury, was first, and Mr. George Wallis, of Old Shifford, Bampton, Faringdon, second, in both the ram classes. Mr. Wallis also secured the third prize and two commendations for shearling rams; the Duke of Marlborough getting the Reserve Number and two high commendations in the same class. Mr. C. Howard, of Biddenham, Bedford, was, as last year, first, with his beautiful pen of shearling ewes, and had the Reserve Number and a high commendation in the same class; Mr. A. F. Milton Druce, of Twelve Acres, Eynsham, Oxon, having a well-earned second prize. The Judges reported of these classes:—

Class 82, *Oxford Down Shearling Rams*, was fairly represented as to numbers, and contained several good animals. No. 750 was a grand-looking, good character of sheep, descended from a line of winners at the Royal Shows, his sire being the first-prize sheep in Class 83, and also the first-prize sheep in the shearling class at Wolverhampton. The grandsire of this sheep was also winner in the class for old rams at Wolverhampton,—a sheep that was especially noticed in the report of that Show. No. 752, the second-prize sheep, was of very good form and character, and if he had had a better head, and had been of better colour, his position *possibly* might have been improved.

Class 83 was not strongly represented as to numbers, but contained several good sheep. The first-prize sheep referred to above, No. 764, is a very good sheep indeed, and well sustains the character of his sire, the first-prize sheep in the class for old rams at the Wolverhampton Show. The second-prize sheep, No. 765, is also a very good style of sheep, and well supports the character of the Oxford Downs.

Class 84. A small entry, numbering only 4 pens. The first-prize pen, No. 771, was a very choice pen, showing a great deal of quality. The second-prize pen, No. 769, was also a good one. The other two pens were also worthy of notice.

The Longwools of any breed were represented by 6 pens of 25 shearling gimmers, all Lincolns. The placing together so large a number of sheep of the same flock is of course one of the strongest tests of uniformity of character; but there was perhaps hardly any class in the show which, excepting one pen, bore the test better than this one. The Judges, who were the same as for the Leicesters, reported:—

We think this class an extremely good one. The first and second prizes are even, with good quality, size, and wool, and a very profitable class of sheep. The third-prize sheep are of great size, with good fleeces, but of quality not equal to the first and second pens.

The Southdown shearling rams were a tolerably large entry, 21, and of fair merit. Mr. W. Rigden's sheep was easily first, Mr. Foljambe's being second, and Mr. Colman's third. The older rams were 13 in number, and a very fine class. Mr. Rigden was again first, and took, besides, the second prize and a commendation. His Royal Highness the Prince of Wales secured the Reserve Number and a high commendation in both these classes. Colonel Kingscote obtained only a high commendation for aged rams, while the New Merton flock improved upon its strength of last year, and took a high commendation, and a commendation in the shearling ram class, and two commendations in the aged class. Lord Walsingham was also first with his pen of ewes; the Duke of Richmond, whose pen was missed from last year's show, being second with a very good pen of four, the fifth ewe being long in the neck, and perhaps making the difference between first and second honours. The Duke was also third in this class. Mr. Colman's fine-bodied sheep (pen 826) are specially referred to in the report of the Judges, Messrs. H. Fookes, of Whitchurch, Blandford; H. P. Hart, of Beddingham, Lewes; and T. G. Saunders, of Watercombe, Dorchester, who say:—

In the class for shearlings there was a large entry, but there was a wide difference between the first-prize animal and any of the others.

The class for older rams, although only half so well filled as to numbers, contained more good sheep, and made altogether a creditable display.

The shearling ewes also formed a good class. We think it well to state that the reason the pen, No. 826, consisting of large and well-developed sheep, did not obtain any favourable notice from us was the remarkable bareness of their ears and even of their faces. This may be, in some measure at least, attributable to high feeding; but, if so, it indicates a degree of forcing which we consider injurious to animals intended for the purpose of breeding, and which, from the printed instructions furnished to us, it is evident that the Society does not, to say the least, wish to encourage.

We take this opportunity of impressing upon exhibitors and breeders generally the importance of paying increased attention to the characteristics of the pure Southdown.

Shropshires were, as usual, very strongly represented, there being 56 rams, and 10 pens of shearling ewes, on the ground. And, looking to the general character of these three classes, Shropshire breeders have, so far as is indicated by animals exhibited in the yard, grounds for congratulation, especially in comparison with last year's Show at Cardiff. Successive Judges have continued for years to impress upon them the desirability of securing a uniformity of type, if this really useful and rent-paying sheep, as it has so often been called, is to obtain the hold which it merits in other parts of England beyond the midland counties. And year after year, with the exception above named, it has been satisfactory to find that the reports show a decided, though slow, advance in this direction. A useful standard was given by the Judges of this class at the Oxford Show, which may, perhaps, be not inaptly repeated here. They then laid down:

1. That a Shropshire sheep should possess great depth of firm flesh, indicated by a good muscular neck, straight and wide back, with ribs well-sprung, and a heavy leg of mutton.

2. That the face and legs should be of a uniformly dark colour, and well-covered head; the fleece thick-set, and free from grey.

The names of the Judges at Hull, Mr. T. Horley, The Fosse, Leamington; Mr. R. H. Masfen, Pendeford, Wolverhampton; and Mr. C. Randell, Chadbury, Evesham, will be an indication that in their awards they have kept these points in view, and their report, which I give in full, is well deserving the consideration of every Shropshire breeder. It is as follows:—

The breeders of these sheep again exhibited their shearling rams in large numbers, and among them were many good animals, the whole class showing a greater approach to uniformity of character, colour, and wool, than has heretofore prevailed. There are still some exceptions, notably one belonging to the owner of the first-prize sheep, so good in all but his head, that but for the coarseness and want of character shown there, he must have taken the place of his companion, whose head, on the contrary, was not masculine enough.

The old sheep were less numerous, but the form and quality of three of them were remarkably good. The Reserve Number also was a good animal. In the rest, character appears to have been sacrificed to size, and, although very useful animals, the Judges felt that they could not confer upon them any distinction.

The yearling ewes, upon the whole, were not as good as in former years; four of the pen exhibited by Lord Chesham were, however, unexceptionable; the other pens containing animals characterised like the yearling rams by improved uniformity of character.

Upon the whole, it may be said of the Shropshire sheep exhibited at Hull that they very fairly represented the character of this very useful rent-paying kind of sheep, marked by hardiness of constitution, large amount of lean flesh, with small weight of offal, and good quality and weight of wool. The exhibitors are entitled to the credit of having done much to enhance the reputation of this valuable breed of sheep, which is now so firmly established in the midland counties.

Among the prize-takers Lord Chesham kept up his reputation by winning the first prize for shearling rams, and for ewes, with sheep of dark-brown faces and legs, and close fleeces. Mrs. Beach was second in the shearling ram class with a sheep of rather looser wool, and longer frame. Mr. Crane was first in the older ram class with a sheep of extraordinary back and rump. In this class Mr. Thomas Fenn was second, and Mr. Joseph Pulley third, while Mrs. Beach won the Reserve Number, as she did also in the ewe class. In this latter class Mr. John Hanbury Bradburn was second and third.

There is no class of sheep which has improved more in the last few years than the Hampshires; and those exhibited at Hull, though few in number, were no exception to the rule of progress. Mr. Morrison was first and second in the older sheep. Mr. James Rawlence had all the rest of the honours in all the classes, with the exception of a commendation given to Messrs. R. and J. Russell in the shearling rams. The report of the Judges, who were the same as for the Southdowns, says:—

These were but scantily represented in any class, but all those exhibited (especially the shearlings) combined great size with good form and fair quality. We desire to bear testimony to the vast improvement which has taken place in this breed during the last few years.

Cheviot sheep were a good, though not a large, show, numbering altogether 16 rams, and 6 pens of ewes. Mr. Thomas Elliott, of Hindhope, was invincible in all the classes, against good sheep in all. Mr. John Robson, of Bymess, got the Reserve Number and a high commendation for the older rams, and the same for ewes; while Mr. R. Shortreed, of Attenburn, Kelso, secured the second prize for ewes, and a commendation in each of the other classes. The Judges, who also judged the Border Leicesters, reported:—

Class 95. Was well represented, and of great quality.
Class 96. On the whole a very superior lot of sheep.
Class 97. The above remark will equally apply to this class.

Of the Black-faced and Mountain Sheep, beyond their picturesqueness, there is little to be said further than what the same Judges add, namely, that classes 98, 99, 100, 101, 102, 103 were badly represented, and, with few exceptions, a very middling lot.

Class 104, consisting of pens of Ten Shearling Wether Sheep, of the same flock, competing for a prize offered by the Hull butchers, was represented by three lots, not deserving any especial mention.

Pigs.

Mr. Wakefield, Steward of Pigs, reports as follows:—

The number of entries in this department was 191, against 176 at Wolverhampton, and 190 at Cardiff. The absentees numbered 10, and the disqualifications on examination as to age 11; but of these latter it should be noticed that they only applied to four exhibitors. The Judges were unanimous in saying that it had never before fallen to their lot to inspect so many pigs of really superior quality, and in some of the classes they had considerable difficulty in coming to a decision, so nearly were the comparative merits balanced.

We would suggest that in future all exhibitors should send their pigs in crates *mounted on wheels;* much trouble and delay, both on arrival and departure, would thereby be avoided, without entailing upon exhibitors any serious outlay.

Subjoined is the Report of the Judges, Messrs. Turner and Lynn, as handed in to the Steward of this department:—

Class 105. This was a moderate class, with the exception of the first and second prize pigs.

Class 106. This class was not at all a good class of animals.

Class 107. The first and second prize pigs in this class were very good, and very nearly equal in merit. There were some other very fine pigs exhibited.

Class 108. This was far below an average class.

Class 109. This was a very good class throughout; the pig to which the first prize was awarded was a good and true specimen of the small breed; there were others in this class of which the same cannot be said.

Class 110. This was not up to the standard of perfection.

Class 111. This class was not well represented.

Class 112. The pigs exhibited were somewhat inferior.

Class 113. This was by no means a good class, and very few entries.

Class 114. There was no competition and no great merit.

Class 115. There were some very good animals exhibited in this class, especially the first and second prizes and Reserve Number.

Class 116. Only 2 entries, and one of them was considered not of sufficient merit to receive a prize.

Class 117. This was a very good class indeed; in addition to the prize animal there were many of great merit; and we commended the class generally.

Class 118. Here we had a good competition, and amongst the lot were several good animals in addition to those to which we awarded prizes.

Class 119. This, in our judgment, was the best class of pigs ever exhibited at the Royal. There were 5 highly commended in addition to the prizes, and we felt compelled to show our appreciation of this class by commending the whole, when there were 22 entries.

Class 120. Here was a great falling off from the last class. There were none to commend beyond the Reserve Number.

Class 121. This was also a very good class, and we thought it necessary to commend it generally.

Class 122. There were a number of good pigs exhibited here; there were three highly commended in addition to the prizes.

Class 123. The best pigs exhibited here were disqualified by the Veterinary Inspector, and those left in competition were but a very indifferent lot.

With regard to the whole Show, it appears a work of supererogation to add anything to the pages which have been already written and read on the subject; but I think it may fairly be said that, taking every description of stock, the Exhibition was one of the best we have ever had. The ground for the Show was very good and conveniently situated; and, although we were somewhat alarmed by the prospect of a level railway crossing so near the Yard, we have the satisfaction of knowing that our fears were groundless, as no accident occurred.

The attendance was large, and all the authorities in Hull appeared to take the greatest interest in our proceedings, using their best exertions for the success of the Meeting.

Thurgarton Priory, August, 1873.

XXI.—*Report on the Exhibition and Trials of Implements at Hull.* By W. J. Edmonds, of Southrope, Lechlade (Senior Steward).

The trials of 1873, although not of so interesting a nature to the general public as were those of the two preceding years, cannot be said to be of less moment to the agriculturist, for the horse is still the motive power employed for the cultivation of the greater part of the arable land of England; and the perfection of the cultivating implements to be used, whether for the economising of labour or for the preparation of the land for the reception of seed, must always be deemed a matter of much importance.

The competition, however, for the special prize given for the best "Combined Stacking-Machine" somewhat relieved the dulness of the trial-fields on the Hessle Priory Farm; and the searching trials to which the machines competing for this prize were subjected could hardly fail to satisfy every one that the Judges did their best to arrive at a just conclusion as to the comparative merits of all which were brought before their notice. The improvement which has been made in them since last year at Cardiff is very considerable; the weak point spoken of by Mr. Wren Hoskyns in his report, namely, "failing to clear the straw at the point of delivery," has, in some of the machines, become the "strong corner;" and it was remarked at Hull that this has taken place with those which deliver at a more moderate speed rather than with others. Nothing could be more satisfactory than the working of several of these most useful additions to the stack-yard; and the result of this year's trial has proved that the Council acted wisely in adopting the suggestion of those gentlemen who proposed at the General Meeting that "A special prize should be given this year at Hull for Combined Stacking-Machines."

Considerable anxiety was caused as regards the trials of ploughs and other implements, from the fact that in the week before their commencement the land had become so exceedingly dry that it was feared they would not work. A heavy rain on the Thursday was therefore most welcome, as the ground thus became sufficiently soaked; and by 12 o'clock on Monday the preliminaries were settled, and the Judges commenced in earnest. The chief interest among the classes of ploughs was centred in those which contained the double-furrowed ones; and naturally so, for as ploughing is very slow and very expensive work, any change which renders it less so is hailed with satisfaction. The substitution of wheels for sole-shoes must reduce friction; and the successful exhibitors, Messrs. Murray and Snowden, with others who were not far behind them in the race, cannot fail to have plenty of orders for these now fashionable and valuable implements. But it appears to me that the plough, of whatever make, has now many rivals: formerly it was the chief implement, and the drag and the harrow were its adjuncts; but when we see the broadshares, cultivators, and scarifiers, the chisel-pointed and duck-footed drags and harrows, we naturally enquire for what purpose were all these articles invented? And the trial-fields at Hull suggested to me the answer, namely, that some combination of them will, in many cases, be made to supersede the use of the plough in preparing land for the barley and root crops.

The Ravensthorpe Engineering Company were so good as to place at the disposal of the Society their steam machinery (with the Manilla rope) as the motive power for testing the draught of the ploughs and other implements with the dynamometer. It answered the purpose remarkably well, and the thanks of the Society are due to them, as well as to Messrs. Aveling and Porter, for the aid given by their road-engine.

As the potato crop was not sufficiently forward to allow of a satisfactory trial with the potato-raisers, the Stewards considered it right to postpone it until a later period. Mr. Penny was instructed to take charge of those which the Exhibitors might leave with him, and three are accordingly in his hands. The trial, through the courtesy of Mr. J. Wells, of Booth Ferry, will take place on his farm; and Mr. T. C. Booth has kindly undertaken to be the acting Steward on the occasion.

A new feature on the show-ground this year was the parade of prize implements down the centre avenue, by which intending purchasers could see and compare them without having the trouble of visiting the different stands, and the arrangement appeared to give universal satisfaction.

XXII.—*Report of the Trials of Ploughs, Harrows, &c., at Hull.* By JOHN COLEMAN, of Escrick, York.*

THE growth of the Implement Trade has been so rapid of late years, and the competitors for the Society's prizes have so increased in number, that, notwithstanding subdivision and extension of similar trials to greater periods of time, the entries have become well-nigh unmanageable; and it is only by a combination of good management on the part of officials, and the untiring energy of Stewards and Judges, that the work is completed in the allotted time, which at Hull extended from Monday, July 7th, to Saturday, July 12th, on the afternoon of which day all the awards were in the Secretary's hands. At Leicester, in 1868, more than two-thirds of the Report was occupied with the trials of Steam Cultivating machinery, and yet, with this important element absent, over three hundred Implements were entered for trial at Hull, and four sets of Judges were found necessary. The introduction of a scale of points for Judging is a great improvement, and when the latter are properly arranged, the work will be simplified, and the decisions more satisfactory both to the Exhibitors and the Judges themselves. The following is a copy of one of the forms supplied.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

SINGLE PLOUGHS.—CLASS ____________

Observer's Name ____________

Date ____________

Catalogue number ____________

Name of exhibitor ____________

Length from point of share to end of breast ____________

Number of horses required ____________

Weight ____________

Price ____________

Number of field for trial with horses ____________

Area of plot ploughed with horses ____________

Time in ploughing plot with horses ____________

Remarks on trial with horses ____________

* The Editor desires to express his thanks to Messrs. Coleman and Roberts for having undertaken, at a moment's notice, to write the Reports of the trials at Hull, in consequence of the sudden indisposition of the gentleman to whom that duty had been entrusted.—ED.

Trial with Dynamometer.

Number of field__________

Weight of earth per square inch per yard run__________

Specified width and depth__________

	Time occupied.	Distance run.	Width.	Depths.	Index before and after.	Nett Index registered.	Ft.-lbs. of work registered per yd.	Weight of earth moved per yard.	Ft.-lbs. work per lb. earth moved.	Draught.
First furrow										
Second ditto										
Third ditto										
Fourth ditto										
Totals .. .. Averages										

Mean areas.

Points of Merit.

	Perfection being	Points awarded.
Weight	50	
Price	50	
Mechanical qualities and strength. (Engineers' opinion) .. .. .. Simplicity. (Farmer Judges' opinion)	200	
Economy in power and draught	120	
Time in trial with horses	..	
Perfection of work with horses	300	
Flatness of sole of furrow	60	
Cut on land side	60	
Neatness of laying slices and burying of vegetation	100	
Efficiency of skim coulter	60	
Totals	1000	

In the case of Double-furrow Ploughs the Judges came to the conclusion that the nomenclature was not satisfactory, and drew up a different list with regard to "points of merit," which, with the marks assigned, is given below.

DOUBLE-FURROW PLOUGHS.—POINTS OF MERIT.

		Perfection represented by	Points awarded.	
Price	..	50		
Weight..	..	50		
Mechanical qualities and strength combined with simplicity ..	..	200		
Economy of power of draught..	..	250		
Ease of management in work and in turning	..	100		
Facilities of transport	..	50		
Time in trial	..	20		
Flatness of sole of furrow..	80	..		
Cut on land-side	20	..		
Packing and angle of furrow slice	100	..		
Efficiency of skim coulter and perfect burying of surface matters	80	..		
Making perfection of work	..	280		
Totals	..	1000		

This arrangement being novel, we are not to expect perfection; the Judges were called upon to fix their scale of points on Monday morning, and Exhibitors were ignorant of the value which would be assigned to the different parts of the implement and its work. It would be very desirable if the points could be determined beforehand and made known to Exhibitors, who would then bring their machinery to trial with a knowledge of what was required: nor would this be difficult to arrange, since a Committee, composed of practical men, aided by a competent engineering authority, would be qualified to settle the question. The Council possesses the right sort of men, and thus the points might be issued with the Prize sheet.

The land selected for the trials comprised seven fields on the Hessle Priory Farm, situated about three miles from the town of Hull—two of these were taken as reserves and were not required,—bordering the Humber, and originally derived from its

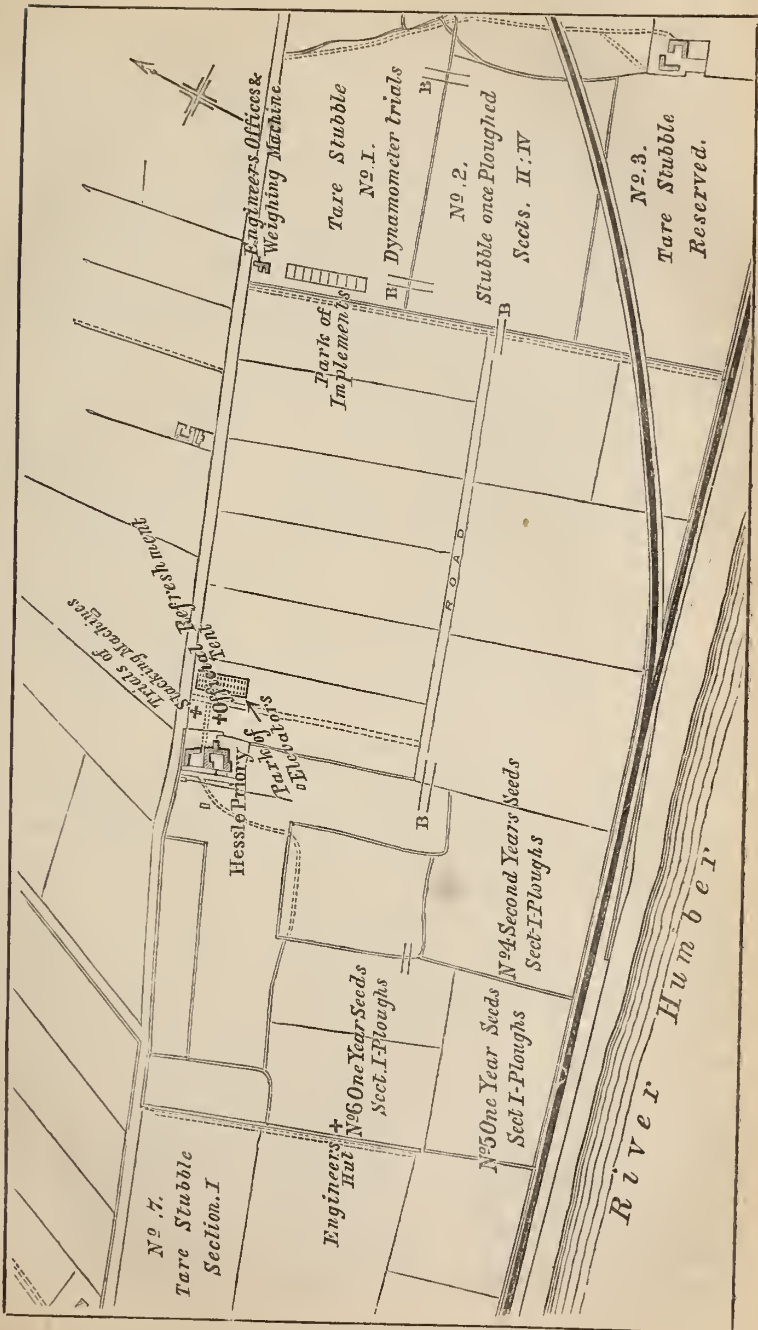


Fig. 1.—*Plan of the Trial Fields on Hessle Priory Farm, near Hull.*

overflow; the soil consists of a strongish warp, varying slightly in natural character, but considerably in consequence of different conditions of cultivation. Thus, Nos. 4, 5, and 6, set apart for the plough trials, were in seeds partly of two years' growth, and consequently, owing probably to two wet seasons, in a very hard unsatisfactory state; whereas Nos. 1 and 2, laid out for the trials of Harrows, Cultivators, &c., had been recently disturbed. No. 1 was a vetch stubble, and No. 2 had been once ploughed since harvest, and consequently worked a full horse lighter. This fact was taken advantage of, the second and conclusive trials for both the light, double, and single ploughs being held in this field. It was fortunate, both for the Society and the Exhibitors, that there was this opportunity for a reasonable test, for it was not fair to expect light-land implements to stand the excessive strain incidental to the tearing up of great masses of soil in an indurated condition: true, such a test discovers weak points, and it may be safely inferred that the machine that stands such work will answer on the lighter soils; but, on the other hand, it must be remembered that light-land implements are limited to a given weight, and makers are naturally anxious to make an implement as light as is consistent with due strength for the work they are intended for. Had no opportunity under more favourable circumstances been afforded for a second trial, the non-successful might with some show of reason have attributed their failure to the untoward condition under which they were compelled to compete.

The sum of 380*l.* was offered, including a special prize of 25*l.* for the best combined stacking-machine. It will be remembered that these useful labour economisers came into competition in connection with threshing machinery at Cardiff. The trials of the latter, however, occupied so much time, that it was impossible to devote such attention to the stackers as their importance demanded, hence it was felt very desirable to repeat the trials. A report of these trials, together with a description of the Implements to which Silver Medals were awarded, by Mr. C. G. Roberts, is appended. Messrs. Clayton and Shuttleworth, who carried off two prizes at Cardiff, did not again enter into competition. The utility of demonstrating by prolonged and exhaustive tests which machines are most likely to give satisfaction to the purchaser was duly appreciated by the public, and scant as were the visitors to the trial fields, there was always a goodly muster in the rickyard as Hessle Priory. It was felt that the offering of this prize for competition in the year devoted to cultivating implements was a praiseworthy innovation on routine, which might be improved upon in the future. That this great Society might add to its utility by studying to anticipate the wants of its constituents and whenever the development of particular machinery was peculiarly desirable, might stimulate invention by the offer of valuable prizes, without regard to whether the particular machine was or was not included in the Classes to be tried. Of course those who have no responsibility, and know nothing of the difficulties attending the management, can readily find fault and offer suggestions; had such carefully studied the arrangements at Hull, they must have admitted that no pains had been spared to secure trustworthy results.

The following is the schedule of prizes offered :—

Section I.—Ploughs.

Subsection A.—Wheel Ploughs.

Class		£.
1.	For the best Plough, not exceeding 2 cwt.	10
	For the second best ditto	5

To be tested at 4 to 6 inches deep, on light land only, as far as practicable.

Extreme length from point of share to end of breast not to exceed 4 feet.

2.	For the best Plough, not exceeding 2½ cwt..	10
	For the second best ditto	5

To be tested at 4 to 7 inches deep, on light and mixed land as far as practicable.

Extreme length from point of share to end of breast not to exceed 4½ feet.

3.	For the best Plough, not exceeding 3 cwt..	10
	For the second best ditto	5

To be tested at 5 to 8 inches deep, on mixed soil and heavy land as far as practicable.

Extreme length from point of share to end of breast not to exceed 4½ feet.

Subsection B.—Swing Ploughs.

4.	For the best Plough, not exceeding 2½ cwt.	10
	For the second best ditto	5

To be tested at 4 to 7 inches deep, on light and mixed land as far as practicable.

Extreme length from point of share to end of breast not to exceed 4½ feet.

Subsection C.—Double-furrow Ploughs.

5.	For the best Plough, not exceeding 3½ cwt.	10
	For the second best ditto	5

To be tested at 4 to 6 inches deep, on light land only, as far as practicable.

Extreme length from point of share to end of breast not to exceed 4 feet.

6.	For the best Plough, not exceeding 5 cwt.	10
	For the second best ditto	5

Class		£
6.	To be tested at 4 to 7 inches deep, on light and mixed land, as far as practicable. Extreme length from point of share to end of breast not to exceed 4½ feet.	

SUBSECTION D.—MULTIPLE-FURROW PLOUGHS.

7. For the best Plough turning three or more furrows, not exceeding 6 cwt. 10

To be tested at 4 to 6 inches deep, on light land only, as far as practicable.

Extreme length from point of share to end of breast not to exceed 4 feet.

NOTE.—*Such Ploughs in Subsections A, B, C, and D, as the Judges may select, will be tested on stubble as well as lea.*

SUBSECTION E.—SUBSOIL PLOUGHS.

8. Best Subsoil Ploughs 5

To follow an ordinary plough and work from 6 to 12 inches below the furrow bottom.

9. Best arrangement of Subsoiler attached to a Single-furrow Plough for ploughing and subsoiling at one operation 5

This Plough must be able to plough 6 inches deep, and subsoil 4 to 6 inches deeper.

10. Best arrangement of Subsoiler attached to a Double-furrow Plough for ploughing and subsoiling at one operation 5

This Plough must be able to plough 6 inches deep, and subsoil 4 to 6 inches deeper.

SUBSECTION F.—ONE-WAY PLOUGH.

11. For the best Single-furrow One-way Plough 5
12. For the best Double-furrow One-way Plough 5

All the One-way Ploughs to be tested at 4 to 7 inches deep, on light and mixed land, as far as practicable, and on both lea and stubble.

SUBSECTION G.—DOUBLE MOULDBOARDS OR RIDGING PLOUGHS.

13. For the best Plough, not exceeding 2½ cwt. 5

To be tested in ridging up land from the flat, moulding up Potatoes, and opening water furrows after ploughing.

SUBSECTION H.—PARING PLOUGH.

14. For the best Paring Plough 5

SUBSECTION I.—PULVERIZER.

15. For the best Plough for leaving the furrow-slice pulverized 5

To be tested at 6 to 8 inches deep, on light and mixed land, as far as practicable.

SUBSECTION K.—MISCELLANEOUS.

16. For the best Plough not qualified to compete in any of the foregoing classes 5

Section II.—Harrows.

Class		£
17.	For the best Light Harrow	10
	For the second best ditto	5
18.	For the best Heavy Harrow	10
	For the second best ditto	5
19.	For the best Chisel Harrow	10
	For the second best ditto	5
20.	For the best Chain Harrow	5
21.	For the best Drag Harrow	5
22.	For the best Harrow, not qualified to compete in the preceding Classes	5

Section III.—Rollers and Clod-crushers.

23.	For the best Light Roller	10
	For the second best ditto	5
24.	For the best Heavy Roller	10
	For the second best ditto	5
25.	For the best Clod-crusher	10
	For the second best ditto	5
26.	For the best Roller or Clod-crusher, not qualified to compete in the preceding Classes	10

Section IV.—Cultivators and Scarifiers.

27.	For the best Cultivating Implement for light land	15
	For the second best ditto	10
28.	For the best Cultivating Implement for heavy land	15
	For the second best ditto	10
29.	For the best Broadshare	10
30.	For the best Implement for cultivating or scarifying purposes, not qualified to compete in the preceding Classes	10
	For the second best ditto	5

Section V.—Digging Machines.

31.	For the best Digging Machine	10

Section VI.—Potato Ploughs and Diggers.

32.	For the best Plough for raising Potatoes	10
33.	For the best Machine or Digger for raising Potatoes	10

The Society reserves to itself the right of postponing the Trial of the Implements in Classes 32 and 33 to a later period than the Hull Meeting, if the Potato crops should not then be sufficiently forward.

Special Prize.

34.	For the best combined Stacking Machine	25

To be tried with sheaf-corn, hay, and loose corn and straw, and worked by horse-power; and adapted for use in conjunction with a steam-threshing machine, if required.

Miscellaneous awards to Agricultural Articles not included in the Quinquennial rotation .. .. Ten Silver Medals.

The conditions as regards Ploughs were as follows:—

The specified weights of the ploughs in each class are to be taken when fitted with two wheels, and with the breast, share, and coulter, as used at work, but are not to include the skim-coulter or any other occasional extra parts such as drag-weight and chain, although employed during the trial.

The standard of excellence of work will be the same as that laid down by the Society for the Newcastle Meeting, viz. :—

> "That the plough should cut the sole of the furrow perfectly flat, leave the land-side clear and true, lay the furrow slices with uniformity, with perpendicular cut of the land-side, leaving a roomy horse-walk. That it should have an efficient skim-coulter, be light in draught, simple, strong, and economical in construction."

Ploughs will be tested by a dynamometer, and drawn by steam-power during such test.

Each plough must go at least one round drawn by steam, and with the dynamometer attached, but not registering, so that it may open its own work prior to having its draught tested. The draught will be registered on not less than four different furrows, and averaged to ensure accuracy.

Each competitor may use a new or sharp share and coulter during the dynamometer trials, but these must be of the same shape and make as those which he has used during the rest of the trial.

When tested on the dynamometer, each plough shall have a share cutting the same width of ground, namely :—

For a 9-inch furrow, not less than 7½ inches wide ; and for a 12-inch furrow, not less than 10 inches, measuring across the wing.

The length from the point of the share to the end of the breast will be measured along the centre of the breast.

The following are the names of the Judges :—

SECTION I.—*Ploughs.*

SUBSECTIONS A and B (*and Miscellaneous Articles*).

JOHN HICKEN, Dunchurch, Rugby.
J. D. OGILVIE, Mardon, Cornhill, Northumberland.
T. P. OUTHWAITE, Goldsboro' House, Knaresborough.

SUBSECTIONS C to K.

MAJOR GRANTHAM, West Keal Hall, Spilsby.
JOHN HEMSLEY, Sheltod, Newark.
J. W. KIMBER, Fifield Wick, Abingdon.

SECTIONS II., III., and IV.—*Harrows, Rollers, and Clod-crushers, Cultivators, and Scarifiers.*

S. ROWLANDSON, Newton Morrell, Darlington.
J. STEPHENSON, The Beeches, Burnham, Barton-on-Humber.
EDWARD WORTLEY, Ridlington, Uppingham.

Combined Stacking-Machines.

HENRY CANTRELL, Bayliss Court, Slough.
C. G. ROBERTS, Shotter Mill, Haslemere.
MATTHEW SAVIDGE, The Lodge Farm, Sarsden, Chipping Norton.

SECTION I.—PLOUGHS.

The Wheel Ploughs were divided into three classes, viz. those suitable for light, medium, and heavy soils. The weights respectively not to exceed 2, 2½, and 3 cwt. As the implements shown by the different competitors in each class were precisely the same in principle, only differing in the strength of material, one description will suffice. I propose, therefore, to describe the ploughs which were tried in the second Class, for medium land, the weight not to exceed $2\frac{1}{2}$ cwt. The only conditions attached to the entry were that the ploughs should be tested at from 4 to 7 inches deep, on light and mixed land, and that the extreme length from the point of the share to the end of the breast should not exceed $4\frac{1}{2}$ feet.

Fig. 2.

a. Square Coulter-clip. *b.* Set Screw

W. Ball and Son, Rothwell, Northamptonshire, who appear, not for the first time, in the prize-lists of the Royal Agricultural Society, were very successful with their well-known Criterion ploughs, taking two first and two second prizes. These ploughs are admirably made, combining strength with quality of workmanship and simplicity. The beam is single, deep, and of sufficient substance. The square coulter-clip with set screw is perhaps the best arrangement that can be used (see Fig. 2), since the coulter can be fixed at any angle and at any part of the beam. It is both simple and effective. The draught is taken direct from the cradle or cock, and not from the beam in front of the body, by a draught-rod. This is not generally considered so good an arrangement, but Messrs. Ball and Son state that it makes no practical difference. One would have thought that the more direct the draught line was with the work, the better. The land and furrow wheels are separately attached to the beam by a single square clip or box, the standard being fixed in any required position. The width of the furrow is adjusted by bringing the wheel-axles nearer or farther apart. The body is attached to the frame by four strong screws. The great merit of these ploughs lies in the cutting surface of the share and the form of the mouldboard, which ensures an unbroken well-packed furrow being laid with the expenditure of the minimum amount of power. The under part of the wing of the mouldboard is cut away, and the slade and sole are not so long as in some other ploughs.

Corbett and Peele. No. 2843, The "Excelsior."—The total length from stilts to cock is 11 feet 7 inches. The beam, 6 feet long, 1 inch by $2\frac{7}{8}$ inches deep, is, with the frame, composed of wrought iron. The attachment of the skip or frame is peculiar. Instead of being bolted to the beam, as is common, the latter is made with two arms, to which the frame, also made to match, is securely attached (Fig. 3). This arrangement gives great strength, which might be increased if the front edge of the frame were fitted with a flange flapping over

Fig. 3.—*Attachment of Frame to Beam.*

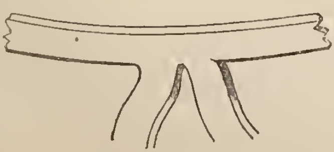
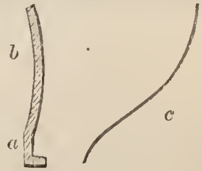


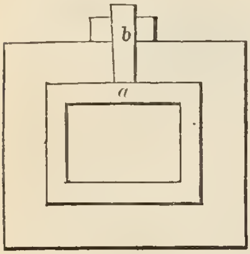
Fig. 4.—*Section of Slade and Frame.*



a. The Slade. *b.* The Frame.
c. The Mouldboard.

the arms. The slade or land side is 2 feet 11 inches long, square for 3 inches, and then bevelled off to meet the surface of the frame, which is also bevelled in the centre, in order to allow of high-cut work, which is much approved of in the district where these ploughs are made (see Fig. 4, which shows the bevelled surface of the frame and the form of the mouldboard). By this arrangement $1\frac{1}{2}$-inch cut can be given to the furrow. The pitch of the share is regulated by a lever neck working in a ratchet. The coulter is adjustable by set screws and a bead on the beam. The mouldboard is stayed by an iron plate, $11\frac{3}{4}$ inches by $\frac{3}{4}$ inch thick. This gives great strength. The wheel fastenings are strong and simple, and comprise a wrought-iron box (*a*, Fig. 5) with screw (*b*). The wheel-arm has two distinct supports; one being the box, and the other the opening in the beam. In this plough the maximum width from the land-side to the widest part of the mouldboard was 15 inches, whereas in both Hunt's and Ball's ploughs the width was 17 inches; consequently the horse-track was too narrow for good work. The object of this arrangement was, doubtless, to lessen the draught; but it is objectionable, as a wide horse-track is very important, in order that the work be not trodden on and injured. The draught in this plough is from the cock.

Fig. 5.



William Hunt, Leicester. Nos. 1627 and 1628.—These ploughs are well made; the beam, which is of wrought iron, varies from $\frac{3}{4}$ to 1 inch thick by $2\frac{1}{2}$ to $2\frac{3}{4}$ inches in depth, according to the class. The cast-metal body is attached by four bolts. The arrangement for altering the pitch of the share is peculiar and meritorious; the slade or sole plate is hinged on the front bolt, as shown at *a* in Fig. 6, instead of being fixed; an eccentric is fitted to the end of the slade shown at *b*, by turning which any required pitch is given, and the wear of the slade compensated for; thus preserving an unbroken curve from the point of the share to the extremity of the turnfurrow. The share being fixed is always firm, and no soil can collect between the share and the turnfurrow. The share is held in place by a stud attached to a rod, and regulated by a screw; the screw works in the backstay of the mouldboard,

Figs. 6–8.—*Illustrations of Mr. William Hunt's Ploughs, Nos.* 1627 *and* 1628.

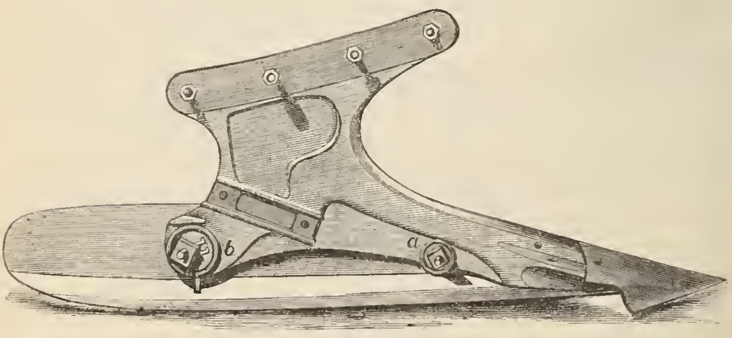


Fig. 6. Inside view of Frame, Slade, and Share.

and is shown in Fig. 7, at *a*. This is both a simple and clever arrangement; the wheels are attached by an ingenious arrangement, whereby the beam is strengthened, and the standards firmly secured, the attachment to the beam through which the axles pass give a firm wide bearing, and an open fore carriage. The old sliding axle is dispensed with,—an advantage, as soil and rubbish were apt to accumulate round it. The coulter is quite straight; the fastenings, of wrought iron and steel, are easily adjusted, to give greater or less inclination, by moving along the beam. The skim is of cast steel, with a small blade attached to the arm or standard by two nuts. The mouldboard, which is shown in Fig. 8, is of a very perfect form, calculated to work clean

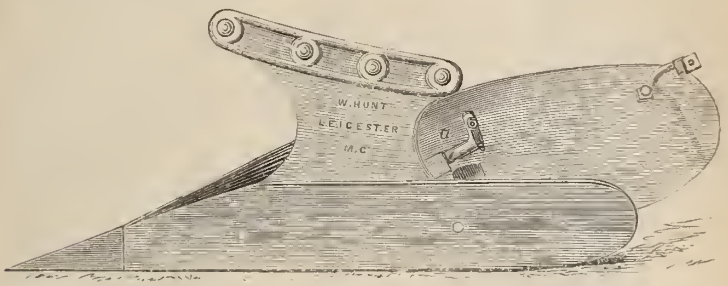


Fig. 7.—View of inner surface of Mouldboard, showing the rod fastenings for the Share.

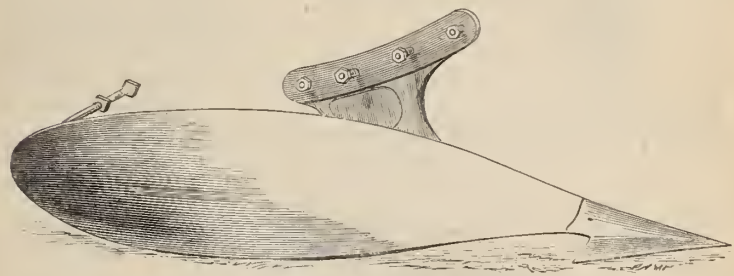


Fig. 8.—External view of Mouldboard.

and lay a well-packed furrow, without absorbing an undue amount of power. The frout portion is a flat surface, the middle part slightly convex, aud the upper portion of the wing projects well over the under part; thus the necessary pressure is given without squeezing.

J. D. Snowdon, of Doncaster, exhibited a strong, useful class of implements. His plough (No. 1178) comprises wooden stilts and wrought channel-iron beam. The former, 6 feet long, are braced so as to increase strength; but are objectionable, inasmuch as the bolts, &c., become loose from the decay of the timber, and, however well made, there are parts where moisture will lodge and soon cause decay. It may be argued that they are easily renewed; but we prefer iron as more durable. The beam, which is very strong, being made of channel or double-flanged iron, measures 6 feet 5 inches, giving a total length to the plough of 12 feet 5 inches. The beam is 3 inches × $1\frac{1}{2}$, by $\frac{3}{4}$ inch in the channel (Fig. 9). There is no meaus of adjusting the share, so as to give increased pitch. The coulter is adjustable by means of a bead or rib on the beam, in the same mauner as already described in Cor-

Fig. 9.

bett's plough. The draught is by a rod from about the centre of the beam. The width of the furrow can be altered from 7 to 12 inches.

E. Page and Co., Bedford. No. 2627.—The total length of this plough is 11 feet. The beam, which is curved, is 2½ inches by 1 inch. The width of the furrow varies from 7 to 12 inches, adjustable by graduated arms. The coulter attachment consists of a wrought-iron clip fitted with a rolling-pin (see Fig. 10); the pitch is adjustable by the set screws. The clip is furnished with an arm, and takes a bearing on the top of the beam. The coulter can be shifted to any position on the beam. A lever neck working in a ratchet alters the pitch of the share to a great nicety. These details, for which Messrs. Page's plough is chiefly noticeable, are here illustrated. Fig. 10 (A, B, and C) represents a side and front view of the coulter-fastenings; the novelty consists in the rib *b* being welded on to the socket *a*, instead of to the beam, as is frequently the case. This enables the coulter to be fixed at any position on the beam of the plough. The coulter is adjustable by means of the set screw *c* and by the eye-bolts *d*, *d*. Fig. 11, A, shows the body of the plough with the

Fig. 10.—*Details of Coulter Fastening in Messrs. Page and Co.'s Plough, No.* 2627.

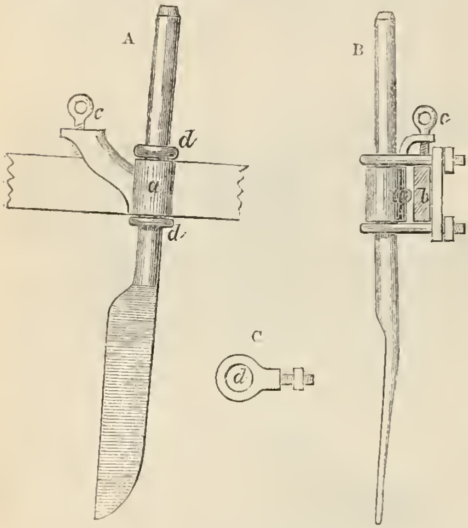
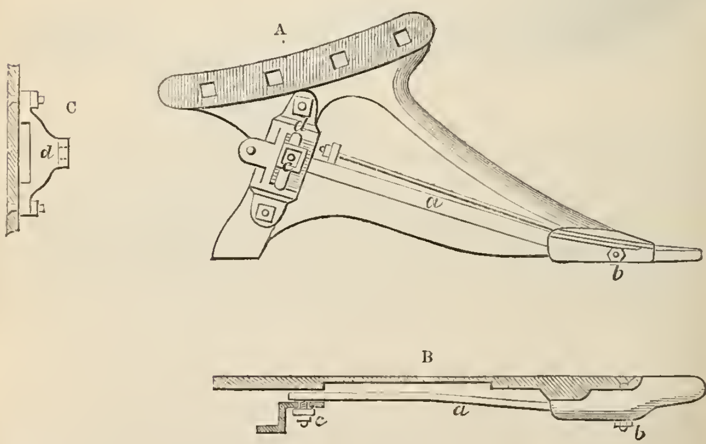


Fig. 11.—*Details of Share-lever Neck in Messrs. Page and Co.'s Plough, No.* 2627.



arrangement for giving pitch to the share. The bar *a* is secured to the body by the bolt *b*, on which the bar pivots to a certain extent. The other end of the bar is secured in any required position by the nut *c* in the coupling *d*. The fan of the coupling-bar is notched to hold the lever-bar firmly. The figure gives a side view and plan, and a view of the coupling.

The entries in the division for Swing Ploughs, Class 4, were numerous.

In addition to the other competitors, *Messrs. Murray and Robinson* appeared. The latter, a local celebrity from Sutton, near Hull, showed a wooden plough fitted with steel breast fittings. The ordinary coulter was replaced by a large revolving knife or wheel, which cutting deep caused a very neat furrow slice at the expense of considerable power. The dynamometer told a tale, as will be seen by a glance at the results given in Table I. (facing p. 538), column 14. The plough made very equable work, but was not approved of by the Judges on account of its liability to derangement from wear and tear. The stilts are strengthened by iron straps. The slade is long, 3 feet 2 inches, which partly explains the accuracy of the work. On the land-side of the share a cutter is attached, which is intended to assist the action of the revolving disc. The

Fig. 12.—*Share of Robinson's Plough with Cutter and revolving Coulter, No.* 3857.

a. Wheel Coulter or Cutting Disc. *b.* Cutter on Land-side.

beam is 4 × 4½ inches. The total length, including stilts, is 12 feet 6 inches, of which the latter comprised 7 feet 6 inches. Nothing in the class made better work; but the heavy draught put it out of court.

John Hodgson, of Louth, Lincolnshire, exhibited No. 1721, comprising an iron beam and wooden stilts, a strong useful implement. The ordinary coulter was displaced by a small disc wheel.

The awards in the four Classes were as follow:—

CLASS I.—WHEEL PLOUGHS not exceeding 2 cwt.

1627.—First Prize of 10*l.* to William Hunt, Leicester.

1456.—Second Prize of 5*l.* to William Ball and Son, Rothwell, Kettering, Northamptonshire.

CLASS II.—WHEEL PLOUGHS not exceeding 2½ cwt.

1462.—First Prize of 10*l.* to William Ball and Son, Rothwell, Kettering, Northamptonshire.

1628.—Second Prize of 5*l.* to William Hunt, Leicester.

CLASS III.—WHEEL PLOUGHS not exceeding 3 cwt.

1460.—First Prize of 10*l.* to William Ball and Son, Rothwell, Kettering, Northamptonshire.

1720.—Second Prize of 5*l.* to John Hodgson, Louth, Lincolnshire.

CLASS IV.—SWING PLOUGHS. For the best Ploughs not exceeding $2\frac{1}{2}$ cwt.

1179.—First Prize of 10*l.* to J. D. Snowden, Doncaster.

1464.—Second Prize of 5*l.* to William Ball and Son, Rothwell, Kettering, Northamptonshire.

DOUBLE-FURROW PLOUGHS.

At the Leicester trials in 1868, three double-furrow ploughs were exhibited, but did not come into competition, as there was no class for them, or for miscellaneous entries in which they might have appeared. We quote from the Judges' Report. "Two Double-furrow Ploughs were put to work by Messrs. Howard and Ransome. Each had two horses attached, and the soil being extremely light (a vetch stubble), they both did their work beautifully, and with perfect ease to the horses; in an ordinary texture of soil we believe the same work could be accomplished by three horses with similar ease, thereby saving one horse and one man. A like attempt was made with a double-furrow plough of very peculiar mechanism, invented by Mr. Pirie, of Scotland, and manufactured by Messrs. Fowler and Co." It is thus evident that attention was at that time being drawn to the manufacture of these ploughs, although they could not be considered as novelties even then. I remember a primitive form of double-furrow plough, entirely of wood, save the share, on the Cotswold hills twenty-five years ago, drawn by oxen, and principally used for light work, such as ploughing for barley after turnips.* The increasing scarcity of labour, and especially the difficulty of finding skilled ploughmen, together with the rise in the price of horseflesh, gave a great stimulus to the manufacture of double ploughs. The dynamometer, confirming practical experience, showed an average saving of twenty-five per cent. in draught over the single-furrow plough. It is an interesting question, which was not solved at Hull, as to how this economy is effected. There is a slight saving in actual weight; thus a single-furrow light-land plough weighs about 2 cwt., whereas the double-furrow implement for the same description of work seldom exceeds $3\frac{1}{4}$ to $3\frac{1}{2}$ cwt.; but mere weight has little to do with draught. The removal of the sole and the slade from one if not both ploughs, and the substitution of a frictional wheel supporting the back part of the frame, is generally supposed to have much to do with the advantage. We regret that time did not allow of some experiments being made to settle these interesting questions. It is probable that some of the

* One of the Judges says, "I made good work with a double-furrow plough made of wood twenty-seven years ago, an excellent implement, made in Nottinghamshire, but, of course, without any appliances for turning or transit."

Table I.—RESULTS OF TRIALS OF SINGLE-FURROW PLOUGHS (CLASSES I.–IV.) AT HULL, 1873.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
								Trial on Dynamometer.						Points of Merit Awarded.										
								Size of Furrows.																
Class and Description.	Catalogue Number	Name of Exhibitor.	Weight.	Price.	Length from Point of Share to end of Breast.	Number of Field	Number of Horses.	Width in Inches.	Depth in Inches	Area of Furrows in Square Inches.	Weight of Earth disturbed per Yard run in lbs.	Foot-lbs. of Work done per lb. of Earth raised. Smallness of result most significant of Perfection	Draught in lbs.	Weight.	Price.	Mechanism, Strength, and Simplicity.	Economy in Power and Draught.	Perfection of Work with Horse.	Flatness of Sole of Furrow.	Cut of Land Side.	Neatness of laying Slices and burying Vegetation.	Efficiency of Skim Coulter.	Totals.	Remarks.
														Perfection being										
			cwt. qrs. lbs.	£. s. d.										50.	50.	200.	120.	300.	60	60.	100.	60.	1000.	
I. Wheel Ploughs, not exceeding 2 cwt.	1627	William Hunt	1 3 26	6 1 0	..	All these Ploughs were tried in Field No. 4: a piece of second year's seeds very dry and hard.	2	8·96	4·82	43·2	96·	12·93	414	50	40	160	110	280	60	60	70	60	890	*First Prize.*
	1456	William Ball	1 3 21	4 16 6	..		2	9·38	4·85	45·5	101·	16·18	515	50	45	130	80	240	50	50	70	40	755	*Second Prize.*
	2812	Corbett & Peele	2 0 0	5 9 0	..		2	9·17	4·67	42·8	95·01	13·41	421·7	50	40	120	100	200	40	40	60	40	690	
	2623	Page & Co.	2 0 0	4 10 6	..		2	..	..	..	..	..	..	50	50	120	..	170	30	40	80	20	560	
	1715	J. Hodgson	..	4 4 0	..		2	..	..	..	..	..	..	50	50	100	..	160	35	30	60	35	520	
	130	Perkins	..	3 17 6	..		2	..	..	..	..	..	..	50	40	80	..	160	30	30	60	30	480	
	1177	J. D. Snowden	..	5 7 6	..		2	Disqualified on account of having no Skim Coulter.																
II. Wheel Ploughs, not exceeding 2½ cwt.	1462	William Ball & Son	..	5 12 6	..		3	11·36	6·97	79·06	175·5	13·05	764	50	50	160	110	290	60	60	80	50	910	*First Prize.*
	1628	William Hunt	2 1 13	6 3 6	..		3	11·64	6·76	78·7	174·7	13·77	802	50	40	170	100	270	60	60	60	50	860	*Second Prize.*
	2843	Corbett & Peele	2 2 0	5 14 0	..		3	..	..	..	..	..	..	50	50	120	..	150	40	40	30	30	510	
	131	C. Perkins	..	4 15 0	..		3	..	..	..	..	..	..	50	50	120	..	150	40	40	30	30	510	
	2627	Page & Co.	2 2 0	4 15 0	..		3	..	..	..	..	..	..	50	50	120	..	130	30	20	40	30	470	
	1718	J. Hodgson	..	4 15 0	..		3	..	..	..	..	..	..	50	50	120	..	150	40	40	30	30	460	
	1178	J. D. Snowden	..	..	..		..	Disqualified on account of having no Skim Coulter.																
III. Wheel Ploughs, not exceeding 3 cwt.	1460	William Ball	..	5 15 0	..		4	..	..	..	..	..	..	50	50	190	..	295	60	60	90	50	845	*First Prize.*
	1720	J. Hodgson	..	5 5 0	..		4	..	..	..	..	..	..	50	50	100	..	150	40	40	50	30	510	*Second Prize.*
	2628	Page & Co.	2 2 14	5 5 0	..		4	..	..	..	..	..	..	50	50	100	..	130	30	20	40	30	450	
IV. Swing Ploughs, not exceeding 2½ cwt.	1179	J. D. Snowden	..	4 10 0	..		2	10·23	5·01	51·25	113·8	12·71	482	50	50	120	110	260	60	60	90	..	800	*First Prize.*
	1164	William Ball & Son	..	5 12 6	..		2	9·37	5·22	48·9	108·5	15·69	567	50	50	160	90	200	50	60	80	..	740	*Second Prize.*
	2844	Corbett & Peele	1 2 3	4 17 0	..		2	8·9	5·4	48·06	106·7	15·88	565	50	50	120	90	200	40	40	60	..	650	
	3857	Robinson	..	5 0 0	..		2	9·03	5·64	50·9	113·0	16·7	629	50	30	100	60	200	60	60	60	..	620	
	1721	J. Hodgson	1 3 6	3 3 0	..		2	9·37	5·22	46·5	103·2	16·18	556	50	50	120	90	150	50	40	60	..	610	
	2995	J. Fison	..	5 5 0	..		2	9·8	5·45	53·4	118·6	13·17	520	50	40	100	95	150	40	40	60	..	575	
	3500	Murray	1 3 22	6 6 0	..		2	9·1	5·74	52·23	115·9	14·62	565	50	40	130	90	150	20	30	50	..	560	

[To face p. 538.]

EASTONS AND ANDERSON, Consulting Engineers R.A.S.E.

Table II.—RESULTS OF TRIALS OF DOUBLE-FURROW AND ONE-WAY HORSE PLOUGHS (CLASSES V.–VII., XI. AND XII.) AND PULVERISERS (CLASS XV.) AT HULL, 1873.

1. Class and Description.	2. Catalogue Number.	3. Name of Exhibitor.	4. Weight. (cwt. qrs. lbs.)	5. Price. (£ s. d.)	6. Length from Point of Share to end of Breast. (Ft. In.)	7. Number of Field.	8. Number of Horses.	9. Trial on Dynamometer. Size of Furrows. Width in Inches.	10. Depth in Inches.	11. Area of Furrow in Square Inches.	12. Weight of Earth disturbed per Yard run.	13. Foot-lbs. of Work done per lb. of Earth raised. Smallness of result most significant of Perfection.	14. Draught in lbs.	15. Points of Merit. Price. (Perfection being 50.)	16. Mechanism, Strength, and Simplicity. (200.)	17. Economy in Power and Draught. (250.)	18. Ease of Management. (100.)	19. Facilities of Transport. (50.)	20. Flatness of Sole of Furrow. (80.)	21. Cut on Land Side. (20.)	22. Packing and Angle of Furrow Slice. (100.)	23. Efficiency of Skim Coulter and burying Vegetation. (80.)	24. Total. (930*.)	25. Remarks.
V. Double-Furrow Ploughs, not exceeding 3½ cwt.	3501	G. W. Murray	3 1 8	11 0 0	3 11	5 1	4 2 oxen	.. 17·51	.. 5·09	.. 89·3	.. 186·6	.. 11·31	.. 701	40 40	160 160	.. 295	95 95	45 45	25 55	10 5	70 75	40 70	485 750	First Prize.
	1180	J. D. Snowden	3 2 0	9 10 0	3 11	5 1	4 3	.. 19·25	.. 5·25	.. 98·5	.. 205·9	.. 12·43	.. 8[illegible]3	35 35	110 110	.. 170	80 80	40 40	65 65	10 10	55 65	40 55	465 660	Second Prize.
	1165	William Ball & Son	2 3 0	9 7 6	3 11	5 1	4 3	.. 16·4	.. 5·3	.. 86·9	.. 181·6	.. 12·69	.. 768	30 30	120 120	.. 160	55 55	30 30	55 50	15 20	80 75	60 50	445 590	
	132	C. Perkins	3 1 0	9 10 0	3 11	5 1	4 3	.. 18·67	.. 5·01	.. 93·5	.. 201·	.. 10·57	.. 708	20 20	80 80	.. 230	75 80	45 45	65 45	10 10	65 55	40 45	400 610	
	2845	Corbett & Peele	3 1 26	8 17 6	3 10¾	5 1	4 3	.. 17·8	.. 4·91	.. 87·5	.. 182·9	.. 13·30	.. 816	25 25	100 100	.. 110	50 50	30 30	60 65	15 15	60 60	50 45	390 530	
	2906	J. P. Fison	3 0 0	9 5 0	3 10	5	4	..	..	..	..	..	..	20	70	..	45	35	65	15	60	50	360	
	2631	E. Page & Co.	3 1 14	8 15 0	3 11½	5	4	..	..	..	..	..	..	20	65	..	40	30	40	10	30	25	260	
	2097	J. L. Baker	3 0 0	9 10 0	4 0	5	4	..	..	..	..	..	..	15	60	..	30	40	35	10	30	30	250	
	1723	J. Hodgson	..	8 10 0	..	5	4	Broke down in Trial.																
VI. Double-Furrow Ploughs, not exceeding 5 cwt.	3502	G. W. Murray	4 1 0	14 0 0	4 4	5 1	4 2 oxen	.. 17·3	.. 5·98	.. 103·4	.. 216·1	.. 11·62	.. 1053	40 40	160 160	95 95	95 95	45 45	25 55	5 5	50 70	.. 65	515 630	First Prize.
	1181	J. D. Snowden	4 0 0	11 10 0	4 4	5 1	4 ..	.. 20·08	.. 5·7	.. 111·4	.. 239·1	.. 12·57	.. 1001	30 30	120 120	165 165	90 90	40 40	60 50	15 15	75 60	.. 40	505 610	Second Prize.
	1166	William Ball & Son	3 0 0	7 10 0	4 6	5 1	4 ..	.. 19·01	.. 5·61	.. 107·2	.. 221·	.. 13·31	.. 956	35 35	.. 120	.. 110	50 50	25 25	70 55	15 20	80 80	.. 55	275 550	
	133	C. Perkins	3 2 4	10 10 0	4 6	5	4	..	..	..	..	..	..	25	..	..	70	45	45	5	45	..	235	
	2907	J. P. Fison	4 0 27	11 15 0	4 4	5	4	..	..	..	..	..	..	20	..	..	45	35	55	10	60	..	225	
	2098	Baker	3 1 1	10 0 0	4 6	5	4	..	..	..	..	..	..	15	60	..	35	35	25	5	30	..	205	
	1721	Hodgson	Withdrawn.																					
VII. Multiple-Furrow Ploughs.	One entry for Trial, but no implement presented.																							

gain is due to the second furrow being deposited with less friction than if it came upon an already settled surface. It would have been easy to have removed the second plough-body and tested the draft of the first furrow only, also to have removed the friction-wheel; but, as we stated above, the Judges had no sinecure to get through the necessary trials.* Owing to the hard condition of the ground, four horses were required to turn two 6-inch furrows. Mr. Murray, of Banff, employed two very powerful cross-bred oxen, and these were able at a greatly reduced speed to move as much soil as three or even four strong horses. In reality, however, they executed much the same force as two horses, since their rate of progress was only about half as fast. The mean of several observations showing the rate of progression to be for the oxen 1·38 feet per second, and for the horses 2·63 feet per second. The oxen worked very steadily; instead of overcoming resistance by a series of jumps forward, they applied their whole weight upon the collar, and gradually the force thus applied overcame the resistance. It will be seen by the table that two horses actually travelled more than five times as fast, the load being very light. The three horses were put to the same work as the bullocks. These experiments were made

Start.	Finish.	Time.	Stops.	Actual Time.	Distance.	Velocity.	Team.
H. ′ ″	H. ′ ″	′ ″	′ ″	′ ″	Yards.	Feet per Second.	
3 46 20	3 56 20	10 0	3 30	6 30	160	1·231	2 oxen.
3 57 0	4 3 30	6 30	1 50	4 40	,,	1·71	,,
4 22 0	4 28 0	6 0	None	6 0	,,	1·33	,,
4 40 0	4 46 20	6 20	None	6 20	,,	1·26	,,
4 29 0	4 35 10	6 10	0 20	5 50	,,	1·37	,,
				Mean rate	..	1·38	
4 15 10	4 16 20	1 10	None	1 10	,,	6·86	2 horses.
5 1 0	5 4 25	3 25	None	3 25	,,	2·34	3 horses.
5 5 25	5 8 50	3 25	1 0	2 25	,,	3·30	
5 1 50	5 8 20	3 30	None	3 30	,,	2·27	
				Mean rate	..	2·63	

by Mr. Anderson, C.E., and will be read with interest, because they go far to show why it is that bullock labour has been

* One of the Judges remarks, "But most likely from the friction being reduced to a minimum mainly by the plough being, to a great extent, suspended by the more recent improvements."

abandoned, the charge for attendance being so much heavier for work done with bullocks than with horses.

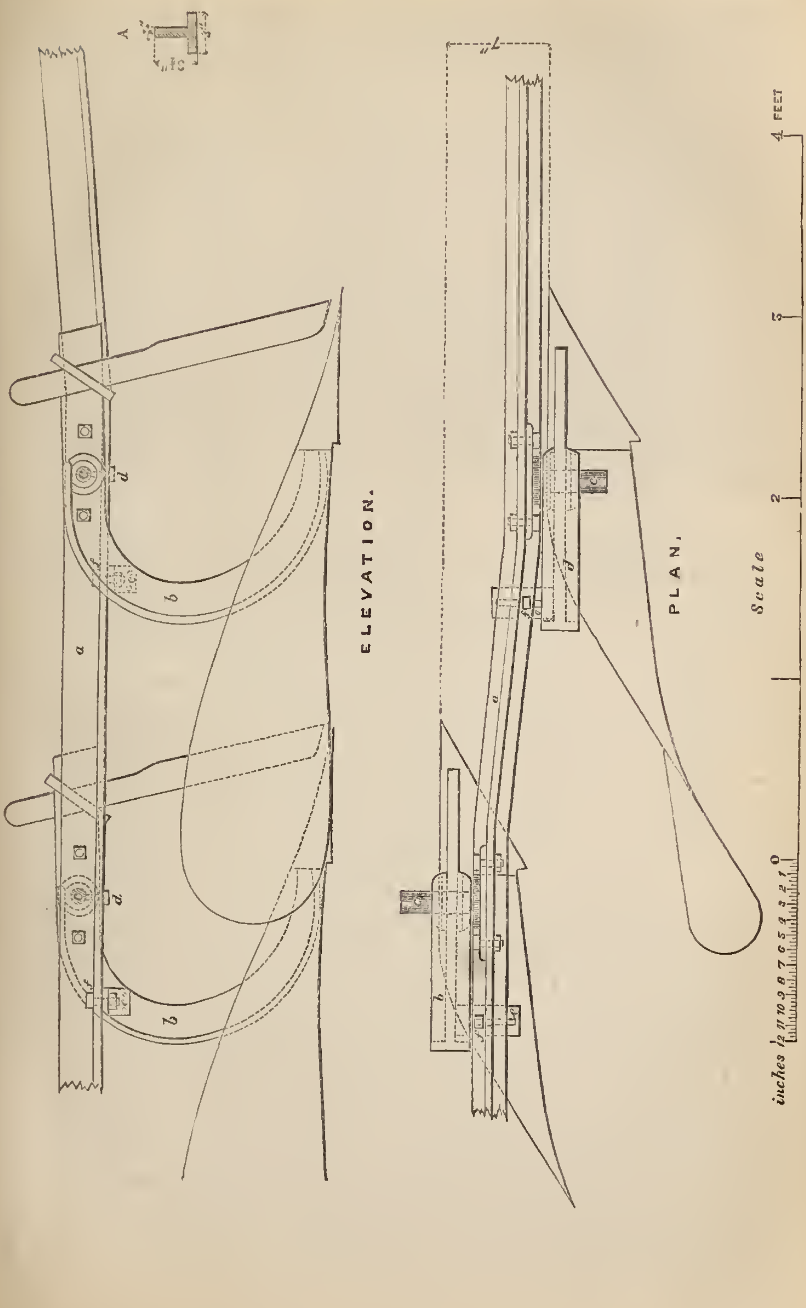
Mr. Murray occupies a farm in Sussex, and the bullocks were on their way there from Banff; and it was a happy thought to employ them at the trial grounds, as they not only answered the purpose admirably, but attracted much attention. Most of the trials were carried on in Field No. 5, but the Judges considered that the soil was too heavy to afford a proper test for the lighter class, and therefore took the second and conclusive trial on the vetch stubble in No. 1 Field. The Society offered 30*l.* in two classes and four prizes, namely:—Class 5 representing light-land ploughs, the limit of weight being 3½ cwt., and Class 6, in which the ploughs were not to exceed 5 cwt. These latter being general-purpose ploughs, the limitation as to the mould-boards was the same as for single ploughs. As most of the implements exhibited by the same makers in the two classesvaried only in strength, we shall more fully describe the ploughs which entered into competition in Class 5, and which were nine in number.

	No.		No.
Baker, J. L. . .	2007	Murray and Co. . .	3501
Ball and Son . .	1465	E. Page and Co. . .	2631
Corbett and Peele .	2845	Perkins, C. . . .	132
Fison, J. P. . .	2996	Snowden, J. D. . .	1180
Hodgson, J. . .	1723		

J. L. Baker, No. 2007.—Composed of one bevel beam of T-iron 3½ × 3½ inches thick, its length 5 feet 7 inches. The plough bodies are also of wrought iron T-shaped, 2½ × 3 inches by ⅜ inch. The method of attaching the bodies to the beam, and allowing them to be set wider or nearer together, is peculiar, and deserves illustration (Fig. 13, p. 541). The bodies are carried on 1½-inch wrought arms, turned and fitted (*c*); a set screw (*d*) holds the body to the arm. On the inner side of the body, and under the beam, is a projecting bracket (*e*) with a slotted hole, in which a bolt (*f*) from the beam fits and ensures rigidity and steadiness. The adjustment by means of the slotted opening is from 8 to 11 inches. The draught is from the cock only, and there is no friction-wheel for carrying the hind part of the frame. The second plough is fitted with a slade 15 inches long. A travelling wheel is provided, but during work it is suspended under the beam and does not touch the ground. The price, with steel breasts, is 9*l.* 10*s.* In this plough there are no mechanical appliances for relieving the ploughman at the land's end, and, although this is of less importance in a light class of ploughs, yet it is a matter on which the Judges laid considerable stress, because sooner or later the man will get tired of the exertion required to bring the ploughs round, and will throw the plough over on the mouldboards, which are thus liable to be broken. Partly owing to the arrangement of a single beam, and also to the absence of a friction-wheel, this plough was very unsteady in work, and was awarded only 250 out of 930 marks.

W. Ball and Son. No. 1465.—Longitudinal beams of wrought iron, which are not quite parallel, being slightly closer together in front than behind—the land-side beam being slightly bent. The Judges were unable to learn the advantage of this arrangement. The Inventor, when applied to, said it was to "get a little more land," *i.e.*, for the ploughs to get more hold. The beams are

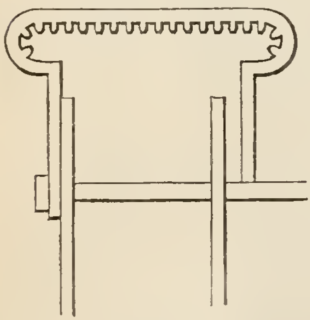
13.—*Plan and Elevation of Messrs. J. L. Baker and Co.'s Double-furrow Plough, A. 2, No. 2007.*



a. Wrought beam of T-iron.
b. Wrought bodies of T-iron.
c. Wrought arms turned and fitted for carrying bodies.
d. Set screw for securing body.
e. Projecting bracket, with slotted opening. } For securing and steadying bodies.
f. Bolt.
A. Section of beam (*a*) and bodies (*b*).

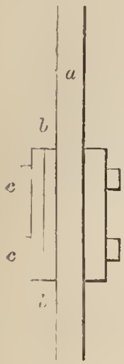
adjustable by 3 screws, and are capable of adjustment so as to plough furrows from $6\frac{1}{2}$ inches to 11 inches wide. The tail of the plough is supported on an upright friction-wheel fixed under the centre of the last mouldboard. This wheel can be altered vertically according to the depth of work required, but has no adjustment laterally. The draught is taken from the cock or bridle, and the latter is made wider than the beams, and is reversible according to the number of horses employed. The first plough is without a slade, the second has one of about 20 inches in length. The mouldboards, share, and coulters are well adapted to secure neat work. Most farmers have heard of Ball's "Criterion" share; there are few better, if as good. The wings of this share come out 7 inches; the mouldboard, of excellent form, is 4 feet long and 9 inches deep. No fault could be found with the work. The beams are not so strong or rigidly attached as to resist strain, and a careful test proved that this plough sprung considerably in work. Under these circumstances, and the fact, above all, that no attempt is made to relieve the workman of his hard labour at the headland—no mechanism whatever being supplied to facilitate turning—the Judges came to a unanimous conclusion that they could not award a prize. The arrangements for securing rigidity are not of a very perfect character; thus this depends wholly upon the collars of the screw-rods. In front the beams are not rigidly connected at all, which, however, is partly compensated for by having one bar for both front wheels. The following sketch illustrates the connection between the fore part of the frames and the cock. After work it was evident that the frames had given way and fallen about $\frac{1}{16}$ of an inch from the beam; and seeing that the attachment of the frames or bodies to the beams was only by two screws, it was not surprising. The frame should be made with a flange resting on the beam; displacement would then be impossible.

Fig. 14.



Corbett and Peele. No. 2845.—This implement has wrought-iron parallel beams 6 feet 10 inches long, the total length of the machine being 11 feet 6 inches. The beams are well braced by 5 connections, and, not being adjustable, are very rigid—an important point. The only means of altering the width is by two $\frac{3}{8}$-inch iron packing pieces, used on the front body only, and by reversing their position the width of furrow can be altered from 8 to 9 inches; to effect this alteration the packing pieces are placed inside the beam. This will be better understood by the aid of a drawing (Fig. 15), from which it will be seen that, in order to widen the furrow, the two packing pieces (*b b*) must be taken out and put on the right-hand side; this is not a long operation, and very satisfactory, inasmuch as we get a certain, although very limited, alteration of furrow, and secure at the same time much more rigidity of beam than is possible with adjusting beams. The question occurs how often do we require a greater alteration than is here provided. Many of the ploughs competing at Hull varied from $6\frac{1}{2}$ to 10 inches, but we question if in ordinary work they would ever be altered more than an inch or two. If required as paring ploughs, it is important that the beams should expand considerably, and for such work the double plough is well adapted. A friction-wheel is provided, which is vertical. The hind plough has a slade 14 inches long, the front plough a land side of 6 inches. As in several other cases the frames, notwithstanding the attachment by two strong screws, dropped a little in work, and it would be better if they had flanges to cover the beam, as is shown in Fig. 16. The draught is taken from the beams just in front of the first mouldboard, and there is a rather ingenious arrangement of double movement at the cock, which is useful when three horses are used abreast, which will be understood by referring to Fig. 17.

Fig. 15.

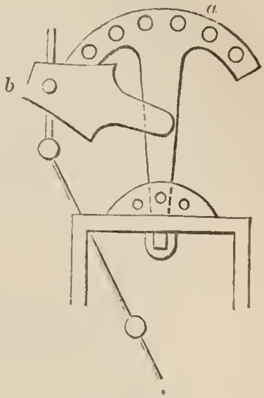


a. Beam.
b b. Packing Pieces.
c c. Bolts.

Fig. 16.

a. Beam.
b. Flange of Frame resting on upper surface of Beam.

Fig. 17.



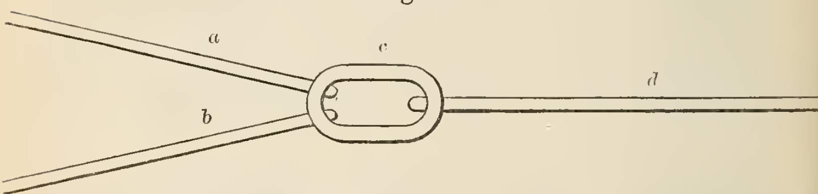
a. Cock.
b. Movable Tongue or Clip carrying Draft-rod.

J. P. Fison. No. 2996.—The wrought-iron beams are composed of $2\frac{1}{4}$-inch rods or bars $\frac{5}{8}$-inch thick, and are somewhat slight even for light work; they are connected by screws working through holes, and are supported by two screw-bolts. The adjustment is from 7 to $9\frac{1}{2}$ inches; and at the greater width the attachment is least strong, which is a defect. The narrower the furrow the more the connections overlap. The draught is taken from the back part of the beams by a rod $\frac{9}{16}$ inch thick, attached to a $\frac{7}{8}$-inch pin, which is decidedly light. The mouldboards measure 3 feet 11 inches from the front of the share, $9\frac{1}{2}$ inches deep, and the wings of the share measure $7\frac{1}{2}$ inches. The back, or second plough, has a slade 11 inches long; and a vertical friction-wheel supports the frame behind. This wheel admits of adjustment. This plough has no lifting apparatus; it is light in construction, and likely to answer on very light land. The price, without extras, is 8*l.* 15*s.*; steel breasts, skim coulters, drag chain, and steel side cap, add 1*l.*: Total, 9*l.* 15*s.* The furrow was well cut and laid, the bottom even, and the work well done.

J. Hodgson. No. 1723.—A short description will suffice for this implement, which was roughly turned out and unfit for competition. The stilts, 6 feet 2 inches in length, are of wood, and, though less costly at the first start than iron, the want of durability is a serious objection, as, after a time, the wood suffers, and a certain degree of play and want of tautness is perceptible. The beams are 5 feet 7 inches in length, by $2\frac{1}{4}$ inches by $\frac{7}{8}$ inch thick, which is not strong, though probably equal to light-land ploughing. The outer beam is very short, and is adjustable by two screws and nuts. The friction-wheel behind runs at an angle. The draught is from the front of the second plough. The slade on the back plough is 15 inches, that on the front plough is 10 inches only. The plough has no mechanical arrangements to assist turning at the headland. The construction was so weak that the arm of the furrow wheel bent, and eventually the machine broke down.

G. W. Murray and Co. No. 3501.—The whole of this plough is of wrought iron, which, though increasing cost price, insures great strength and durability. The beams, which expand, allow of a furrow of from 6 to 10 inches; the adjustment is effected by one screw and slot behind, and in front by one pin, which acts as a wedge, and further by a screw-bolt in the centre. The land-furrow wheel is adjustable by a wedge. The beams are made of 2¼ inches by ⅝ iron. The beams are 4 feet 2 inches long. The ploughs are raised or lowered by means of Pirie's patent leverage, which is used by Mr. Murray. This consists of a land-side wheel, acted upon by a leverage from the handles; and the plough, raised on one side, is readily turned, although it must be allowed that a second wheel or skid, to take a bearing on the right side also, is preferable. No slade is employed on either plough. The coulter attachment slides on a projection on the beam. Here again, as in several instances, the draught is taken from the bridle or cock—an arrangement that was not considered by the Judges so perfect as when the draught comes direct from the centre of resistance. The best attachment is by a rod to each frame joined together by a link, and this terminating in one rod again (Fig. 18). These frames are very well stayed; indeed, no other plough in the class appeared so strong, or capable of such good

Fig. 18.

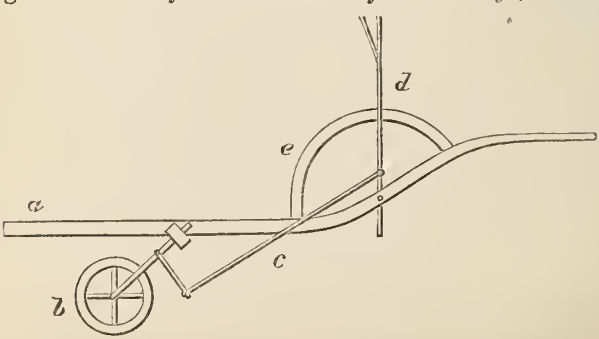


a. Draught-rod from hindmost plough.
b. Ditto from front plough.
c. Link.
d. Single rod to bridle.

work. One point, however, was not liked, and that is the position of the land-wheel during work, which is nearly in the centre of the plough, and consequently interferes with steady motion, although to a certain extent it allows the plough to suit itself to the inequalities of the surface. The work was not cut clean, owing, it was said, to some defect in the under surface of the share, but also probably to the want of steadiness in the plough. The bottom was left very ridgy.

E. Page and Co. No. 2631.—A few words will suffice to describe this implement, as there is really nothing of novelty to chronicle. Beams of wrought iron 2 inches by ¾ inch, attached by two bolts and capable of variation, from 7 to 11 inches. The draught is taken from a point in each beam rather in advance of the front plough: this is a good arrangement. The frames are adjustable by a slot. The ploughs are supported by a vertical friction-wheel behind.

Fig. 19.—*Sketch of Perkins's Double-furrow Plough, No.* 132.

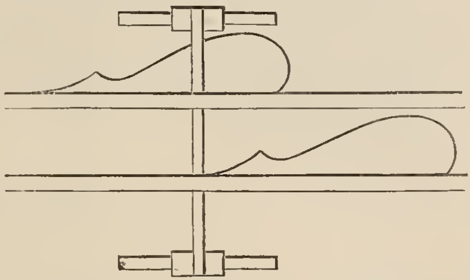


a. The beam.
b. The land-side wheel.
c. The connecting rod.
d. Lever spring arm.
e. Bow, with notches to secure the spring bolt.

The turning at the headlands has to be done entirely by the workman. The price, without skims, is 8*l*. 15*s*.

Perkins. No. 132.—Parallel beams, of good construction; but unfortunately it was evident, both by the work and examination, that the parts were badly balanced and that the beams, $2\frac{1}{4}$ inches by $\frac{5}{8}$ inch, were much too light to resist strain of ordinary work. They are well braced with $1\frac{1}{8}$-inch bolts. The draught is taken from the first stay. The friction-wheel is on an angle, but is not adjustable—a decided omission. The mechanical arrangements are excellent. Two lifting-wheels near the centre of the plough form a fulcrum on which the plough turns with the greatest ease. These wheels are actuated by a leverage from the handles or stilts, kept in place by a spring-catch working in a bow. The preceding sketch (Fig. 19) will give some idea of the mechanism. Fig. 20 shows the position of the lifting-wheels: when the plough is being

Fig. 20.—*Plan of part of Perkins's Double-furrow Plough, No.* 132.



turned during work the right-hand wheel is so much more forward than is here shown, that it is quite clear of the furrow. No slades on either plough. The implement made fair work; but it was evident that the work would have been much better and the draught lighter if the beams had been more rigid.

Snowden. No. 1180.—The peculiarity in this plough consists in the principal beam being of wood, 6 feet 8 inches long, $3\frac{1}{2} \times 4$ inches. The right-hand beam of iron can be expanded so as to vary the furrow from 7 to $10\frac{1}{2}$ inches. The stilts are iron, and the beam is braced with iron, so as to render it very strong. The Judges were unanimous in expressing disapproval of this mixture of wood and iron, which is doubtless used on account of lightness and rigidity, and it is a noticeable fact that this plough sprang less than any other; but in time the points of connection between the two materials will become loosened from the decay of the wood, and then the plough will lose its form and work. This plough has a very efficient lifting-apparatus, consisting of a land-side wheel, which slides on a bar so as to be placed farther or nearer the beam. On the other end of the bar and coming down behind the first plough is a skid, and on the land-side wheel and skid the plough is raised clear of the ground, the necessary leverage being obtained by a connecting-rod to the stilts. So perfectly balanced is the plough when supported as described, that it rides round at the land's-end, without the slightest assistance being necessary from the ploughman. The friction-wheel is adjustable and bevelled, and can be raised and lowered three inches by a nut working in a slot on the mouldboard frame. The Judges considered this a well-made implement. Fig. 21 shows the plough in work; a side elevation. Fig. 23 is a plan of the same, giving a better idea of the combination of wood and iron, and a general idea of the construction. Figs. 22 and 24 give a side elevation and plan of article 1181, precisely similar in construction, only made entirely of iron. Fig. 25 is an enlarged plan showing the mechanism: *b* is a strong screw with double nuts, and *a a* are slots, by which the width of the furrow is adjusted; *c*, the cross-bar to which

Figs. 21–24.—*Side Elevations and Plans of Snowden's Double-furrow Ploughs, Nos.* 1180 *and* 1181.

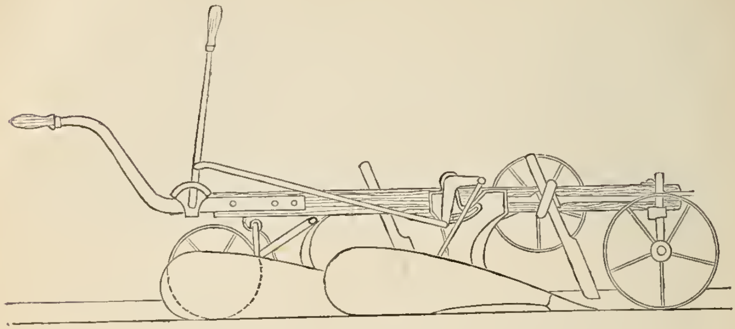


Fig. 21.—Side Elevation of No. 1180.

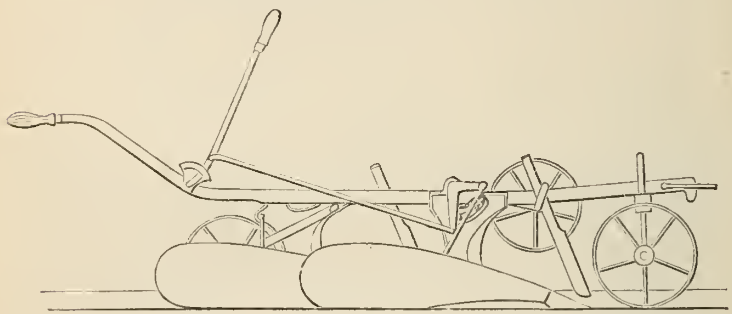


Fig. 22.—Side Elevation of No. 1181.

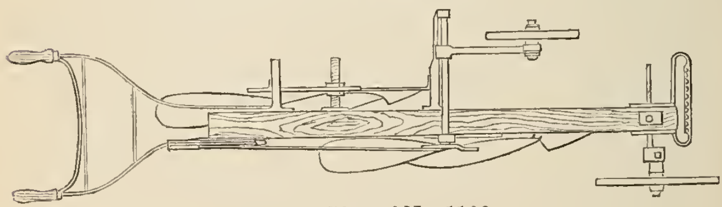


Fig. 23.—Plan of No. 1180.

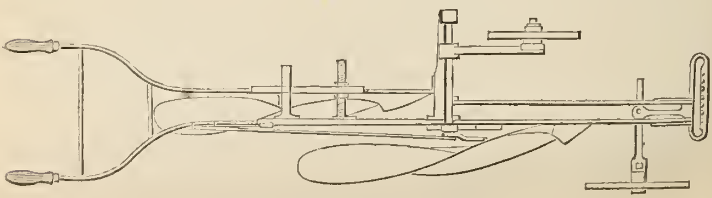


Fig. 24.—Plan of No. 1181.

the standards of the land-wheel and slipper are attached. It will be seen that the position of the wheel in reference to the beam can be shifted on the cross-bar. Fig. 26 illustrates the manner of working the lever *a* in order to raise the plough out of work. The dotted lines represent the position of the wheel and slipper during work. The black lines show the same lowered to raise the plough out of the ground and carry it round the headlands. It will be at once evident that the wheel and slipper being nearly opposite, and at the same level, the plough rests upon a broad bearing, and is turned by the horses with great ease, no assistance being required by the attendant.

Figs. 25 and 26.—*Enlarged Plan and Elevation, showing the mechanism of Snowden's Double-furrow Plough, No.* 1180.

Fig. 25.

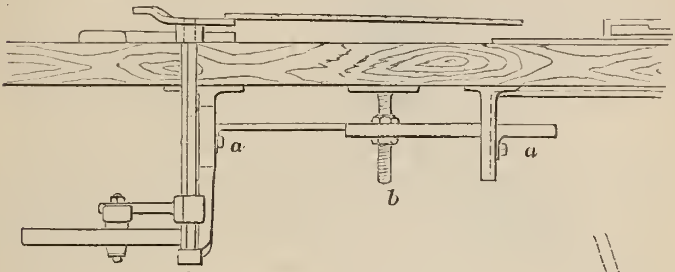
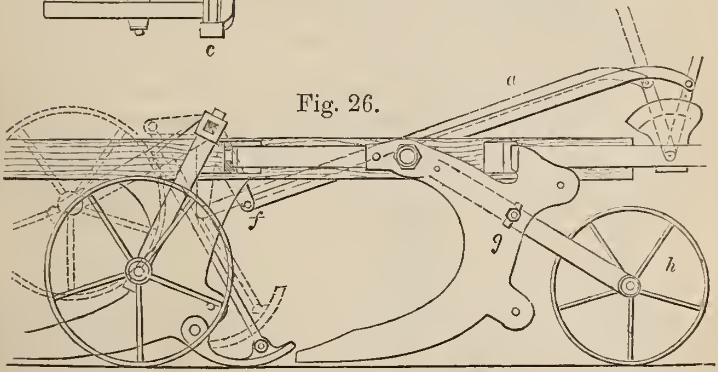


Fig. 26.



a. The lever handle. *d*. Position of land-side wheel during transit.
e. Position of slipper during transit. *f*. Lever. *g*. Screw for altering position of friction-wheel *h*.

The points of merit awarded after both the first and second trials are given in Table II. (facing p. 539); and it will be observed that those for "Economy in Power and Draught" are included only in the results of the second trial of the ploughs selected for testing with the Dynamometer.

The extremely unfavourable condition of the land in Field No. 5 rendered it difficult to register the draught closely, consequently it was considered desirable to give a second trial in all cases where there was the least probability that better results could be made under circumstances more suitable in soil to the character of the implement. A portion of the vetch stubble being at liberty was set out into plots, and here the ploughs of the following makers were tried, viz., Messrs. Ball, Corbett, Murray, Perkins, and Snowden ; and each implement, after executing its allotted portion, was removed to the Field No. 4, where the Dynamometer was worked by means of one of Fisken's light-rope Steam Cultivating Apparatus, which, from its steadiness of motion, and facilities for throwing in and out of gear at the travelling windlasses perfectly independent of the engine, was well qualified for the work, and infinitely superior to horse-power, which was formerly used. The third column gives the results of the Dynamometer-tests.

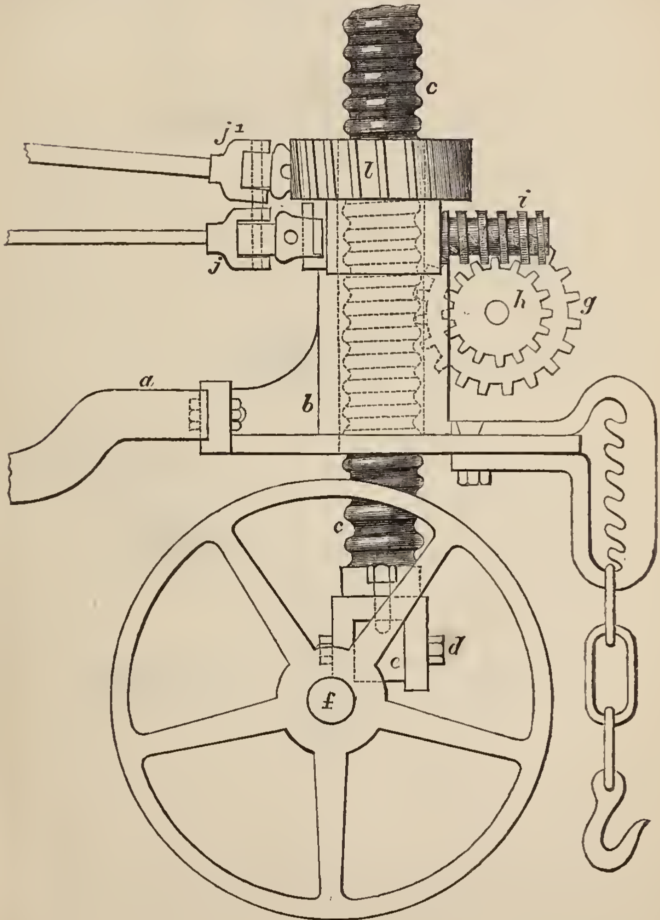
The First Prize of 10*l.* was awarded to G. W. Murray and Co., Banff, N.B., for Article No. 3501 ; and the Second Prize of 5*l.* to J. D. Snowden, Doncaster, for Article No. 1180.

Class 6.—Double-furrow Ploughs not exceeding 5 cwt.

This class was for general-purpose ploughs, to be tested under the following conditions: to the depth of from 4 to 7 inches, on light and mixed land as far as practicable; the extreme length from point of share to end of breast not to exceed 4½ feet. Eight entries were reduced to 6, by the withdrawal of Hodgson and the non-appearance of Lewin. In some cases the implements exhibited, being exactly similar in construction to, only stronger than, those already described in Class 5, will not require more than a passing notice ; I shall therefore direct attention chiefly to such as possess different arrangements. Both trials took place in Field No. 5.

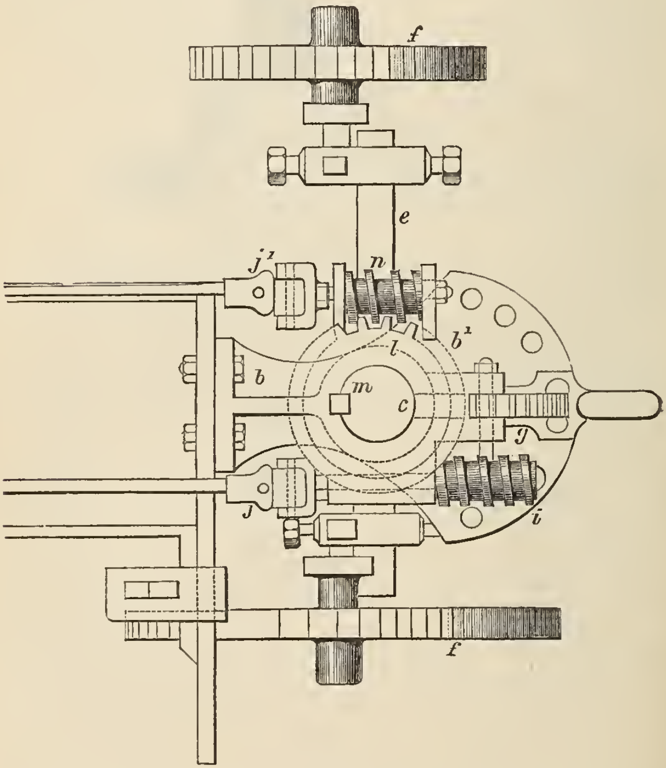
J. P. Fison. No. 2997.—This implement is composed of parallel beams of wrought iron, strongly connected by bolts. The draught is from a bolt about the centre of the plough. The novelty consists in a combined lifting and steerage apparatus fixed in front, illustrations of which are attempted in Figs. 27 and 28 (pp. 549 and 550). The raising part consists of a revolving screw with a small wooden roller at the end; as this is lowered, the front part of the frame is raised out of the ground sufficiently for the shares to clear, and thus the plough is carried round, taking a bearing on the wooden roller in front, and on the friction-wheel behind. There are, however, serious disadvantages in the arrangement: first, it requires some exertion on the part of the attendant to turn the winch-handle fixed between the stilts sufficiently to raise the frame, and again to lower it when the plough has been turned; secondly, the base is too narrow to allow of the implement turning without being held up by the attendant, and we much question if in practice he would take the trouble to work the winch at all. The steerage is sensitive, although arrived at by greater complication than is necessary. The figures represent a side elevation (Fig. 27) and plan (Fig. 28) of the front portion; and a detached central section of the socket through which the revolving screw passes is shown in Fig. 29; the wooden roller is not shown in these drawings. *a* shows a portion of the framing of the plough. *b* is a cast-iron socket and bracket bolted to the framing *a*. *c* is the revolving screw or rack rod, which in the illustrations, taken from the patent specification, is shown jointed by a bolt or pin, *d*, to the axletrees, *e*, of the wheels; whereas in the implement shown at Hull, this screw is quite separate from the wheels, and terminates in a wooden roller, so that when the screw is lowered the roller takes the ground, and the wheels are raised with the frame. *g* is a pinion mounted in bearings b^1 on the socket *b*, gearing with the revolving screw. *h* is a worm-wheel keyed on to the axis of the pinion *g*. The worm, *i*, gears into the worm-wheel, and is connected by a universal joint or coupling with a rod, *j*, extending back to the handles, and provided with a winch-handle,

Fig. 27.—*Elevation of the front portion of Fison's Double-furrow Plough, No.* 2997.



by turning which the revolving screw is actuated, either for altering the depth or taking the ploughs up at the headland. *l* is a worm-wheel, through which the revolving screw passes, also carried on the socket *b*, which is enlarged at the upper part, as shown in Fig. 29, to receive the boss of the worm-wheel, and provided with screws, l^1, working in a groove to retain the wheel in place and allow of its being rotated independently of the socket b^1. The worm-wheel, *l*, is fitted with a gib-key, *m*, received in a corresponding key-groove formed longitudinally in the revolving screw, to allow of the latter turning with the wheel, *l*, and yet allow the latter to move with the socket freely up and down in the screw or rack. A worm, *n*, gears with and operates wheel *l*, for guiding the wheels *f*. The worm is also connected by a universal joint with a rod extending back to the handles, and similarly provided with a winch-handle; both the friction-wheel and the steerage-wheels have bevelled edges,

Fig. 28.—*Plan of the Front Portion of Fison's Double-furrow Plough, No.* 2997.



and the former is set at an angle. Strength is gained by the bodies being split, with wings attached on different sides of the beam seen in Fig. 30. The coulter attachment is somewhat peculiar; the centre of the clip being slightly rounded allows sufficient adjustment of the coulters by the set screws. The Judges were by no means favourably impressed with this complicated arrangement, and do not expect to see it brought into general practice.

Fig. 29.—*Central Section of Socket in Fison's Double-furrow Plough.*

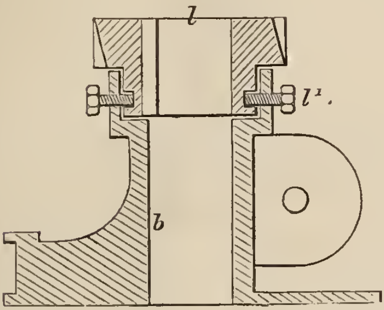


Fig. 30.—*Frame Attachment.*

a. Beam. *b b.* Split frames.

Murray and Co. No. 3502.—This is a strong useful implement, composed of wrought iron and steel, castings being almost entirely dispensed with. The beams are $2\frac{1}{2}$ inches deep by $\frac{3}{4}$ inch wide, and $2\frac{1}{4}$ inches by $\frac{7}{8}$ inch, and expand from 6 to 15 inches, being regulated by two screws and one wedge. The lifting arrangement is different from that in the light-land plough, and, as will be seen by reference to Figs. 31 and 32, p. 552, is both original and simple. Attached to the beam by a simple clip and pin is a stud with a crank bearing welded to it. Upon this stud the lever works with a slipping wedge below, which rests upon the crank-bearings; a rod from the wedge extends back to the ploughman's hand, and terminates with a catch near the end of the lever. A number of holes in the lever and a similar hole in the catch allow of the rod being fixed by a pin in any position requisite to keep the wedge in its required place, according to the depth required; or of its being thrown up altogether, when the wedge slips in and keeps the plough out of the ground by bringing the land-wheel more backward and more nearly into a vertical position. The great merit of this arrangement is simplicity. There is nothing to get out of order; let the plough be ever so roughly used, the leverage or lifting apparatus cannot be injured. Another considerable advantage of the lever stud and bearings is that they are all contained in one piece, and held to the beam by a simple pin, which can be knocked out, and the whole affair, including the land-wheel, shifted backwards or forwards, as may be required. A central wheel is held to be a disadvantage, placing the plough too much upon the balance. Here we can put it in whatever position experience proves to be best. Something will depend upon the nature of the land to be dealt with. In wet clay-land, at any rate, the wheel should be in a forward position; in dry soils, where the bottom is hard and the plough has a tendency to run out, a backward position is held to be best. Murray's arrangement allows of alteration, and this is a point of considerable merit. The draught is taken from the cock, which appears to be a mistake. In work, possibly owing to the too central position of the land-side wheel, the plough was not steady; though an improvement on the work of the lighter plough; and the bottom

Figs. 31 and 32.—*Plan and Section of Messrs. Murray and Co.'s Plough, No. 3502.*

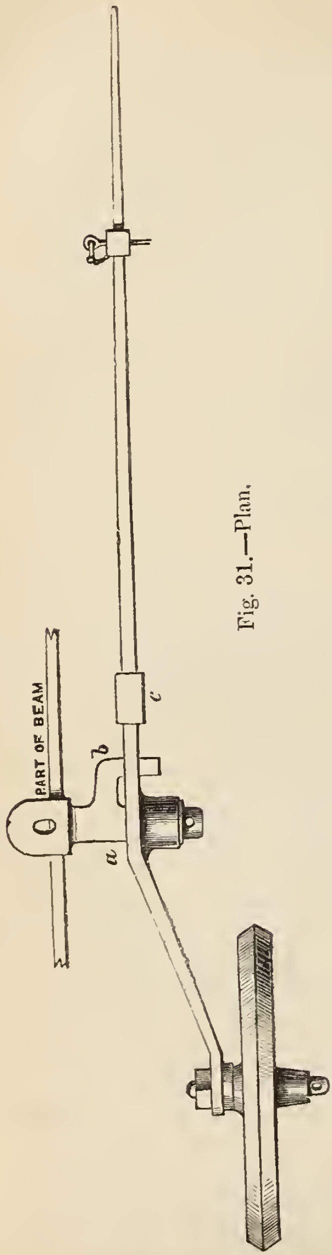


Fig. 31.—Plan.

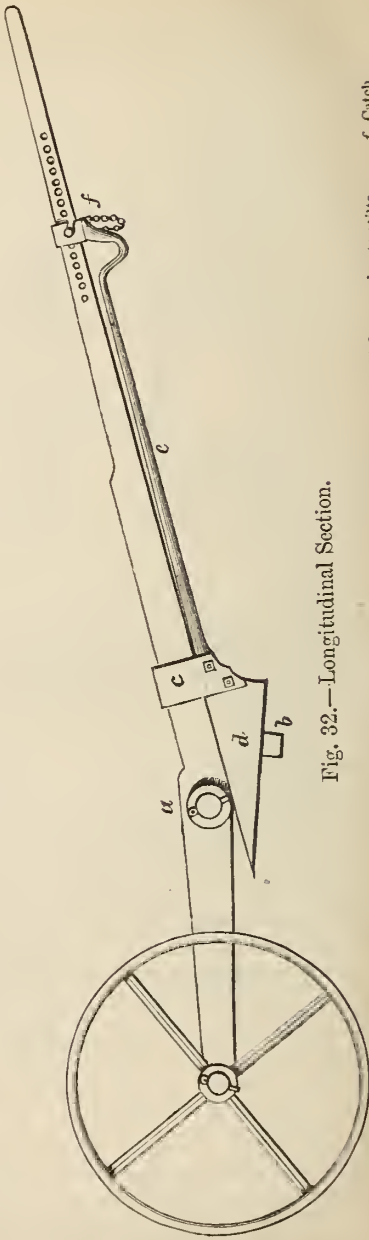


Fig. 32.—Longitudinal Section.

a. Stud. *b.* Crank arm forms a support for the wedge. *c.* Wedge stay. *d.* Wedge. *e.* Rod from wedge to stilts. *f.* Catch.

was rather rough. The price, 14*l.*, includes cast-steel shares and mouldboards. Considering the amount of wrought iron and steel, this is not out of the way.

Snowden. No. 1181.—Here we have wrought-iron beams 1 inch by 2½ inches, with the same lifting apparatus and angular friction-wheel as in No. 1180. The beams are adjustable from 7 inches to 12 inches by a strong bolt in the centre and 2 nuts working in slots at either end. The land wheel during work was well forward, consequently the plough travelled steadily. The wheels are fitted with removable bushes, costing 9*d.* each, which save the naves of the wheels from wearing out. This implement was less rigid than that with a wooden beam, and the engineer found that it sprang considerably. Neither plough has a slade. The friction-wheel is altered by a rack behind the plough raising 3 inches. The beams are not well constructed.

The other makers who competed produced implements made in the same manner as those of theirs already described, only stronger. Messrs. Murray, Ball, and Snowden were drawn out for a second trial, the particulars of which are recorded in Table II, facing p. 539.

The work by Ball's plough was very good in both classes; but the Judges considered that its having no mechanical appliances for relieving the plough was an objectionable feature, especially in the heavier implement. The First Prize of 10*l.* was awarded to G. W. Murray and Co., Banff, N.B., for Article No. 3502; and the Second Prize of 5*l.* to J. D. Snowden, Doncaster, for article No. 1181.

There were no entries in Class 7 for multiple-furrow ploughs. Judging by the power required to draw double-furrow ploughs in land like that of the trial grounds at Hull, it is evident that any further complication would render the implement cumbersome and unwieldy. Multiple-furrow ploughing belongs to steam cultivation, and only by such a power can such implements be economically driven.

The Judges were quite of one mind as to the inutility of continuing prizes for subsoiling implements by horse-power, at any rate as regards Classes 8 and 9. It is quite true, as we trust will be seen by the annexed reports, that several ingenious arrangements for combining subsoiling and ploughing in the same implement were shown; but if the operation be ever so desirable, the great power required to effect really good work makes it far too expensive to be pursued. With steam the case is different, as it gives abundance of power; and by reducing the area worked at one time, the implement can be driven through the soil at a pace that produces most beneficial results. In each of the following classes bearing upon subsoil ploughs, the Judges found sufficient merit to justify an award; but at the same time they recommended that such work, if necessary at all, should be carried out by steam-power.

Class 8.—Best Subsoil Plough to follow an ordinary Plough, and work from 6 to 12 inches below the furrow bottom.

Messrs. Ball, Bentall, and Murray entered in this class. Owing to the unfavourable condition of the land, the trial taking place in No. 5, the strongest field of all, W. Ball and Son withdrew their implement (No. 1485), which was evidently unsuited for such work. It consisted of an ordinary ridging plough, from which the breasts had been removed. The sock could be fitted with shares of different widths, varying from 4 to 8 inches, flat under and slightly cone-shaped on the top (Fig. 33). The beam carried a single wheel in front running in the furrow.

Fig. 33.

Murray. No. 3503.—The beam in this implement is very strong, carrying a double tine, acted upon by a leverage similar to that employed for the heavier double plough in Class 6, only a spring is substituted for the wedge. When out of work and turning, both central wheels are level; when in work, the furrow-wheel rises to suit the bottom by a slot in the wheel-arm, and the depth is regulated by a slot on the axle. It was first tried with the two tines, but, though six horses were attached, it would not work; it did better with one tine. The subsoil-tines are fitted with steel points, 3 inches wide. A furrow was opened with one of Ball's single-furrow ploughs; this was 4 inches deep. The average of moved soil, taken in five places, was $4\frac{7}{10}$ inches. Price of implement, 8*l.* 17*s.* 6*d.* As will be seen from the plan and elevation (Fig. 35), the framework is steadied by travelling on four wheels. The front wheels both travel in the furrow; the central ones are only level when the subsoil is out of the ground and the implement is being turned at the headland. The object of the four wheels is to steady the subsoiler in work and prevent a severe shock to the ploughman in case the tine comes in contact with a stone. The tine or tines are fixed in the slot-holes of a short beam, and can be regulated in the said slots to any required depth (see Fig. 34). This tine-beam has a stud fixed near either end, and upon these studs two links connect it to the main beam of the plough in front and to a turning-stud, from which is a lever, one end extending back to the ploughman's hand and the other to the landwheel; and to the other end of the turning-stud is a shifting crank, to which the back-furrow wheel is attached, a slot in the crank allowing the wheel to be set to suit any depth of furrow. When the plough comes to the end or to any obstruction and requires to be raised, the ploughman lifts the lever into the position shown by the dotted line in the elevation (Fig. 35); the tines are raised up and thrown back, and the wheels are brought down level in consequence of the crank to which they are attached being of different lengths. The depth can be regulated a matter of three inches by altering the position of the lever-handle, and further adjustment can be made by altering the tines, as described. Owing to the extreme hardness of the subsoil in Field No. 5, it was found necessary to remove one of the tines. After this the work appeared successful as far as horse-power was capable of showing its merits, when, unfortunately for Mr. Murray, the spring which holds the catch in the notch broke, and further trial was prevented.

Fig. 34.

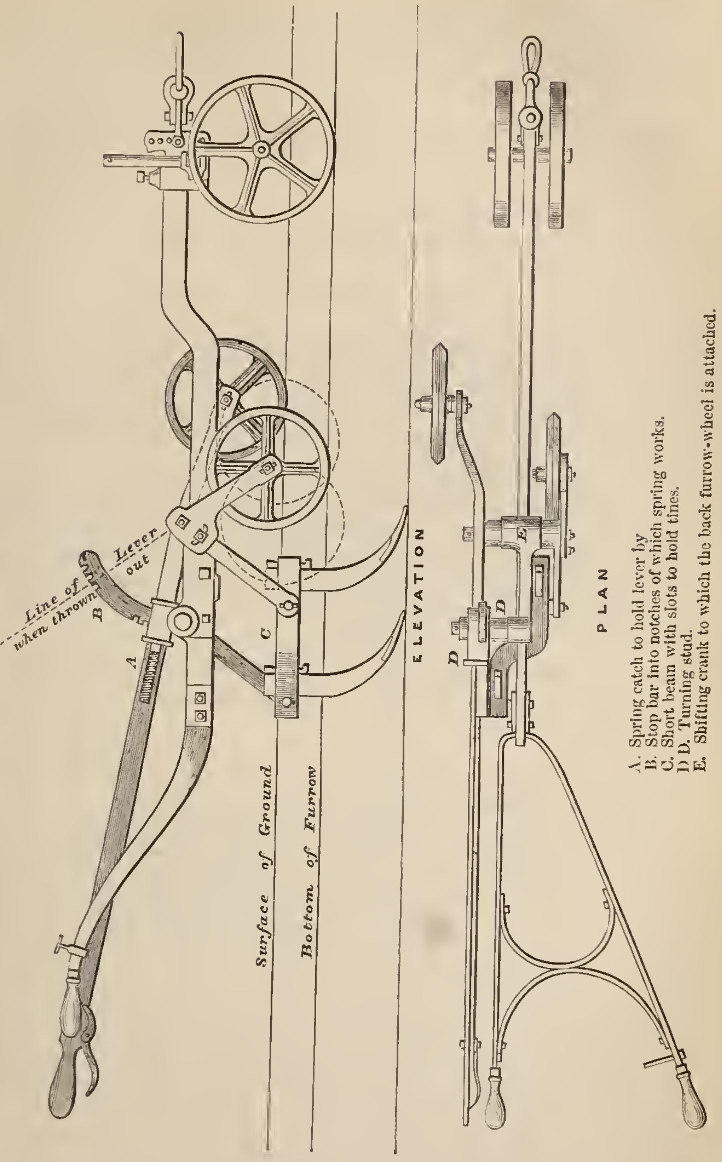
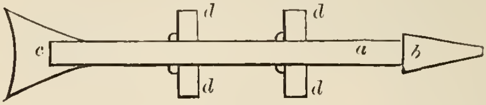


Fig. 35.—*Plan and Elevation of Messrs. Murray and Co.'s Subsoil Plough, No. 3503.*

Bentall. No. 398.—This implement comprised a wrought T-iron beam, 4 × 4½ inches × ½ inch, similar to that used in their broadshare, which, indeed, is capable of being converted into a subsoiler. In the centre of the beam is an ordinary cast-iron body, carrying a subsoiling-tine in front, and a cutting-wing behind, the former 2 inches in width and the latter covering 6 inches; and on each side of the body, in addition, there are two transverse cutters, which are removable. The length of the body is 3 feet 5 inches. There is one wheel in front under the beam. The great length of the beam renders it very difficult to steer. The work done was good, the power not unusually great. Average

Fig. 36.—*Bird's-eye view of Body and Cutters of Bentall's Subsoil Plough, No.* 398.



a. Cast-iron body. *b.* Point. *c.* Wing below. *d d d d.* Transverse cutters.

depth moved, ascertained by three measurements, was 6¼ inches. It is quite evident that operations of this nature are unsuitable for horse-drawn implements, and, if necessary at all, are only exceptionally required. In those cases steam is the proper power, and indeed the only power capable of doing really efficient work, so that the policy of continuing these prizes is doubtful.

Of the two implements tried, Bentall's was much cheaper, costing 5*l.* 5*s.*, and, notwithstanding the excessive labour required to keep it in its place (see Table III., p. 560), which would be reduced considerably by the addition of a second wheel in front, it made good work, was strong and simple in construction, and was therefore awarded the prize.

Class 9.—Best Arrangement of Subsoiler attached to a Single-furrow Plough, for ploughing and subsoiling at one Operation.

Four entries—viz. Ball, Corbett and Peele, Mellard (Trent Foundry), and Murray.

Ball and Son. No. 1468, price 7*l.*—The subsoil-beam is attached to the centre of the plough-beam, and terminates in a handle between the stilts, and thus the tines, either single or double (shown in Figs. 37 and 38), follow the plough. A catch between the stilts on a cross-plate keeps the tines in work, or supports the subsoil-beam, when it is desirable to have it up at the land's-end. The tines are capable of working from 4 to 6 inches deep. These implements were tried on the vetch stubble in Field No. 1, where the condition of the soil was more favourable than in Field No. 5. At first the double-tine was used, but the power required was so considerable, that the single tine, carrying a 5-inch share, was substituted and made good work. The plough was fitted with a digging-breast. The subsoil-shares vary in width from 3 to 5 inches. The total depth, ascertained by several measurements, was about 11¼ inches, of which the furrow was 5¼ inches, and the soil broken up by the subsoiler fully 6 inches. The work done was very good, but as the tine follows the plough, the horses, unless they are driven singly on the land, must trample upon the work and undo much of the advantage gained by the disturbance. This is a serious defect, yet those implements in which the subsoil part preceded the plough were so defective in balance and so topheavy, that the tail of the plough could not be kept into the work. Indeed, here again the Judges were driven to the conclusion that subsoiling, at any rate in connection with a single-furrow horse-plough, was altogether a mistake.

Fig. 37.—*Ball and Son's Double-tine.*

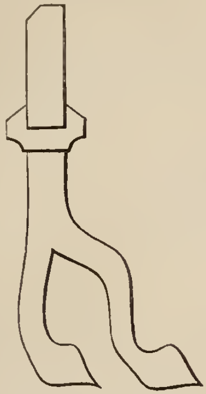
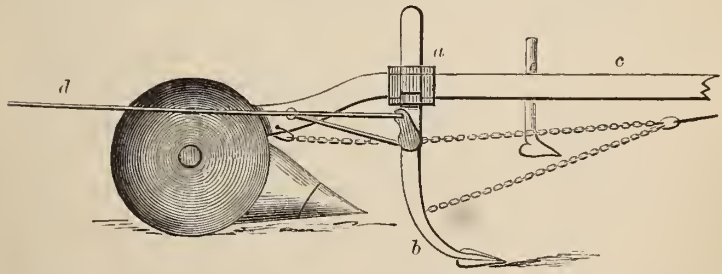


Fig 38.—*Ball and Son's Single-tine.*

Mellard and Co. No. 4321.—One of the ordinary disc ploughs, with subsoiling-apparatus attached to the beam in front. A turned axle carries the subsoiling-tine. This arm has four grooves at its extremity, one inch apart: a set screw fits in these grooves and holds the tine to its required position, which is capable of alteration within the limits of these grooves. A lever-arm for raising or lowering the subsoiler terminates at the stilts, and is readily actuated

Fig. 39.—*Messrs. Mellard and Co.'s Disc Plough, with Subsoiler attached, No.* 4321.



a. Attachment of tine on turned axle.
b. Subsoil-tine with draft-chain, and an iron rod to strengthen it.
c. Beam.
d. Lever-handle for stilts.

by the ploughman. The draught is taken partly from the beam (*c*) above the mould-board and partly from the front of the subsoiling-tine (*b*), the two draught-rods uniting in a common ring in front. This is a good arrangement. The axle is stayed by a $\frac{7}{8}$-inch round rod at the back, connecting it with the beam. This implement, which is meritorious both in its workmanship and construction, unfortunately did not come into competition, as a preliminary trial proved the weakness of the beam, which sprung considerably between the point of attachment of the arm and the body of the plough. Fig. 39, giving a side view, will assist the reader to form some idea of the implement. The axle comes out 18 inches from the beam. The price complete is 6*l.* 15*s.*

Corbett and Peele. No. 2846.—This implement comprises an ordinary heavy-land plough, to which is attached a beam to carry the subsoil-tine, which, as in Mellard's, precedes the plough. The whole of the draught is taken from the plough-beam, which is evidently a bad arrangement, and probably accounts for the unsteadiness, tendency to kick, and difficulty in steering, which were very great. The principle of subsoiling before the plough is correct, inasmuch as we thus avoid treading on the work; but in all the machines so arranged, at any rate as regards one-furrow ploughs, the balance is so injuriously affected that an even good furrow is out of the question. This implement is well made, and looked much more like business than some others. The leverage for taking the tine out of work is shown in Fig. 41. The subsoiling-tine, which

Fig. 40.—*Plan of Messrs. Corbett and Peele's Plough with Subsoiler attached, No.* 2846.

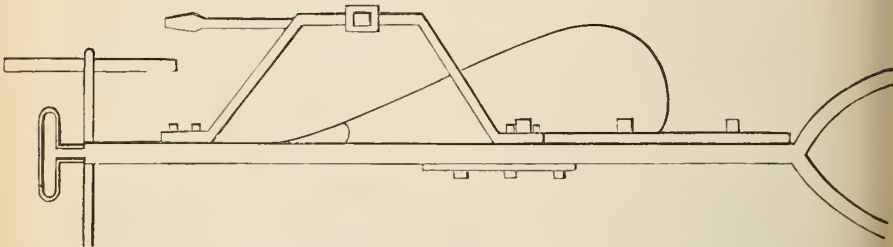
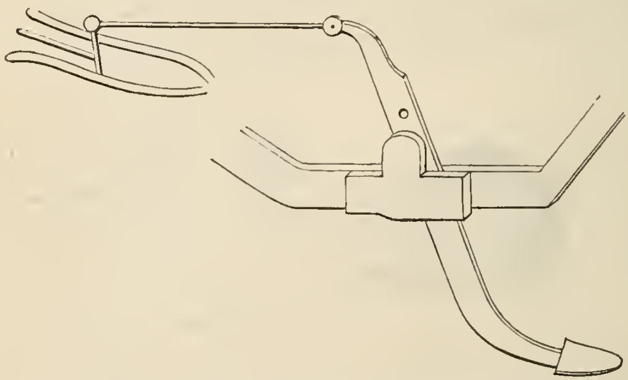


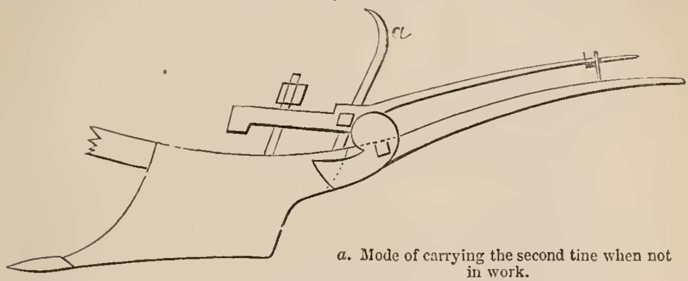
Fig. 41.—*Subsoil-tine attached to Messrs. Corbett and Peele's Plough, No.* 2846.



is 3 inches deep by ¾ inch thick, is fitted with adjustable points, varying from 2½ to 6 inches. The soil was well moved to a depth of about 5 inches below the furrow. The defects appear to arise from improper draught-attachment and from the tine not being set wide enough from the plough-beam. This will be seen by reference to Fig. 40. The points, instead of travelling in the centre of the horseway, are much too near the hard ground, and the draught is greater than it need be in consequence. The subsoil-attachment costs 2*l.* 10*s.* extra; the plough alone 5*l.* 5*s.*

George Murray and Co. No. 3504.—Here, as in Ball's plough, the subsoil-frame is attached behind the mouldboard of a strong swing-plough. The beam of the subsoil-tine is carried on an axle from the beam of the plough. One or two tines can be worked, according to the soil. The socket of the hind one is fixed, but the front one shifts on a cross-bar, so as to work in the centre of the horse-track when only one tine is used. The depth is regulated in two ways: first by a stop on the end of the subsoil-beam, clipping the plough-beam, as seen in Figs. 42 and 43; and secondly, by lowering or raising the tines themselves.

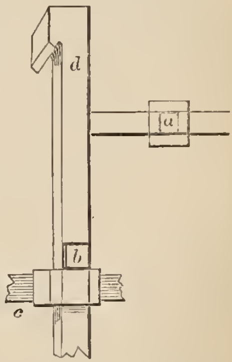
Fig. 42.—*Messrs. Murray and Co.'s Swing Plough with attachment for Subsoiler, No.* 3504.



a. Mode of carrying the second tine when not in work.

Fig. 43 is a bird's-eye view of the subsoil frame. *a* represents the movable socket of the front tine; *b* is the hind tine; *c* the axle carrying the subsoil beam; *d* the subsoil beam, with clip to cast plough beam in front. The work was well done; the total depth about 10 inches, of which the average was $5\frac{1}{2}$ inches ploughed and $4\frac{7}{8}$ inches subsoiled. The action of the tine behind the plough appears to steady the implement. By adopting a peculiar arrangement of bridle it is quite possible to draw the plough by horses in line and all walking on the unploughed ground, and in this way the objectionable horse-treading is avoided. The price of Murray's implement, complete with the two tines, is 8*l.* 10*s.*

Fig. 43.



This class was tried in Field No. 1 on comparatively light land, yet it was evident from the exertions of the horses, and is proved by the tables appended, that the operation of disturbing the subsoil is work more suitable to steam than horse-power; and after the trials at Hull we think the Society would be justified in withdrawing the prizes for subsoilers to follow an ordinary plough, represented by Class 8, and for combined single-furrow plough-subsoiler. The fact of implements being brought forward to compete for prizes is no proof of utility; for they will come, if only made for the particular occasion and cast on one side ever afterwards.

The Prize of 5*l.* was awarded to William Ball and Son, of Rothwell, Northamptonshire.

Particulars of the implements competing in Classes 8 and 9 will be found tabulated on page 560.

TABLE III.—RESULTS OF TRIALS OF HORSE PLOUGHS (CLASSES VIII.–X. AND XIII., XIV., AND XVI.) AT HULL, 1873.

1.	2.	3.	4.	5.	6.	7.
CLASS.	Catalogue Number.	EXHIBITOR'S NAME.	Price.	Number of Horses.	Number of Field.	REMARKS AND DESCRIPTION.
			£.			
VIII. Subsoil Ploughs, to follow an ordinary Plough.	398	Bentall	5 5 0	4	5	*First Prize.* Beam of plough made of wrought T-iron. Depth of work:—Plough furrow, first test, 4 inches deep, subsoiler, $7\frac{1}{2}$ inches; second test, 5 inches, and $6\frac{1}{2}$ inches deep. The land exceedingly heavy and difficult to work.
	3503	Murray	8 17 6	4	5	A 4-inch furrow was first ploughed, and then the subsoiler from $3\frac{1}{4}$ inches to $6\frac{1}{2}$ inches deeper.
IX. Subsoiler attached to Single-furrow Plough.	1468	William Ball	7 0 0	4	1	*First Prize.* This plough consisted of a common plough frame, with a digger breast, a tine being fixed behind to follow in the furrow. Depth of furrow, 5 inches and $5\frac{1}{4}$ inches; subsoiler, 3 inches and 6 inches deeper.
	2846	Corbett & Peele	7 17 6	4	1	Common plough, with tine fixed in wrought-iron bracket, and running in previous furrow. Depth of furrow, $4\frac{1}{2}$ inches and 6 inches; subsoiler, $8\frac{1}{2}$ inches and $11\frac{3}{4}$ inches deeper.
	3500	Murray	8 10 0	4	1	Single tine behind common plough. Depth of furrow, $5\frac{1}{4}$ inches and $5\frac{3}{4}$ inches; subsoiler, $4\frac{3}{4}$ inches, and $5\frac{1}{8}$ inches deeper.
X. Subsoiler attached to Double-furrow Plough.	2847	Corbett & Peele	9 17 6	4	1	*First Prize.* Depth of furrow, $5\frac{1}{2}$ inches to 6 inches; subsoiler, with 7-inch point, $6\frac{1}{4}$ inches and $5\frac{3}{4}$ inches deeper, earth well moved.
	1470	Ball	12 10 0	4	1	Furrow, 5 inches to 7 inches deep; subsoiler, with 3-inch broad point, 6 inches to 8 inches deeper.
	3506	Murray	16 2 0	4	1	A two-tined cultivator; broke in trial.
	3505	Murray	13 0 0	4	1	One-tine failed in work and broke. Price as ordinary double-furrow plough, 11*l*.

XIII. Ridging Ploughs under $2\frac{1}{2}$ cwt.	1472	William Ball	4 10 0	2	1	*First Prize.* Length of plate to end of share, 3 feet. Expands from 15 inches to 24 inches.
	2848	Corbett & Peele	4 17 6	2	1	Length of plate to end of share, 3 feet $8\frac{1}{2}$ inches. Expands from 18 inches to 28 inches. Price includes 2 mouldboards and 3 shares or points.
	1634	Hunt	4 7 6	2	1	Sole plate, 3 feet 2 inches. Expands from 12 inches to 25 inches.
	4321	Mellard's Trent Foundry	4 7 6	2	1	Sole plate, 3 feet 3 inches. Mouldboard, 3 feet $6\frac{1}{2}$ inches long, with the point. Expands from 21 inches to 25 inches.
	3507	Murray	5 5 0	2	1	Sole plate, 3 feet 11 inches, length of breast $44\frac{1}{2}$ inches. Expands from 15 inches to 24 inches. A well-made plough; worked well, but had no front wheel.
XIV. Paring Ploughs.	1633	William Hunt	6 6 0	2	..	*First Prize.* Share cuts 10 inches. Mouldboard 8 inches; in all 18 inches.
	1473	Ball & Son	..	2	..	A paring share adapted to fit any of Ball's common ploughs. Price 9*s*.
	2074	Hill & Smith	..	..	..	Wrong entry, ought to have been entered in broadshare Class.
XVI. Miscellaneous Ploughs.	3508	Murray	..	..	..	A large plough with skim coulter attached, paring off a slice from the surface, and throwing it to the bottom of the previous furrow, to be covered up by the furrow turned over by the large plough from below that from which the skim had been taken from the top. This implement worked badly. No other implement was in competition, and there was no prize awarded in this Class.

EASTONS AND ANDERSON, Consulting Engineers R.A.S.E.

Class 10.—Best Arrangement of Subsoiler attached to a Double-furrow Plough, for ploughing and subsoiling at one Operation.

In this Class were three competitors, Messrs. Ball, Murray, and Corbett; the first two were double entries, varying according to strength, &c.—indeed representing the two forms of double ploughs, those under and over a given weight. The stronger frame being, however, best adapted to resist the strain of the subsoil tine, we shall direct attention to the heavier implements. We believe Corbett and Peele were the first to combine and patent the arrangement of a subsoiler in front of a single-furrow plough, and having omitted to include double-furrows in their specifications, the notion was made use of first by Murray and Co., and afterwards by Ball and Son. There is this advantage in the double-furrow over the single-furrow arrangement, viz. that by displacing the first plough and substituting for it the subsoiling tine, the balance of the implement is not seriously affected, and one is sure of good work, inasmuch as the broken-up subsoil is at once covered over by the second plough; but it is generally admitted that the chief advantage of the double-furrow system is for light soils, where three horses yoked abreast can do the work of two pairs in single ploughs, and on such land subsoiling is seldom necessary, and would often be injurious. However, the ability to apply such an apparatus at a reasonable cost is a point of merit that deserves recognition, and even if it is only very occasionally that we require to disturb the bottom, it will be found very convenient to be able to do so in so simple a manner, and so efficiently, as was done by all the competitors.

Corbett and Peele. No. 2847.—The beams are strengthened by a cross-brace, which can be applied in this plough, because the beams do not expand, as in most others. A third wheel is introduced, which, running close to the furrow-slice in front of the subsoiler, increases steadiness of work. As in the other ploughs shown by this firm, some slight mechanical aid is afforded in turning by the alteration of the land-side wheel. The draught was reasonable. The depth of work was noted during each trial with the following results:—

(1.) Ploughing, 5½ inches; subsoiler, 6¼ inches. (2.) Ploughing, 6 inches; subsoiler, 4¾ inches. (3.) Ploughing, 6 inches; subsoiler, 5¾ inches.

The price appears comparatively reasonable, viz. 9*l.* 17*s.* 6*d.*, which is apportioned as follows: as double-furrow plough, similar to the one which competed in Class 6, 8*l.* 10*s.*; subsoiling-apparatus, 1*l.* 7*s.* 6*d.*

In the first illustration (Fig. 44) the plough is shown with the subsoil-tine out of the ground, and the land-side wheel in a vertical position, to facilitate turning at the headlands.

In Fig. 45 the plough is shown in the same condition, but inclined, in order to show the connecting-rod working conjointly with the lever for raising and depressing the subsoil-tine and land-wheel. At the same time it will be seen that the two are united by the rod *a* (Fig. 45), and that action on the lever-handle *b* must affect both the wheel and the lever-tine. The brace already spoken of as giving rigidity to the beam is seen at *c*. The drawing also shows the wheel-fastenings and the new arrangement of bridle and cock, described in the notes on the double-furrow ploughs.

Figs. 44–46.—*Messrs. Corbett and Peele's Double-furrow Plough, with Subsoiler attached, No.* 2847.

Fig. 44.

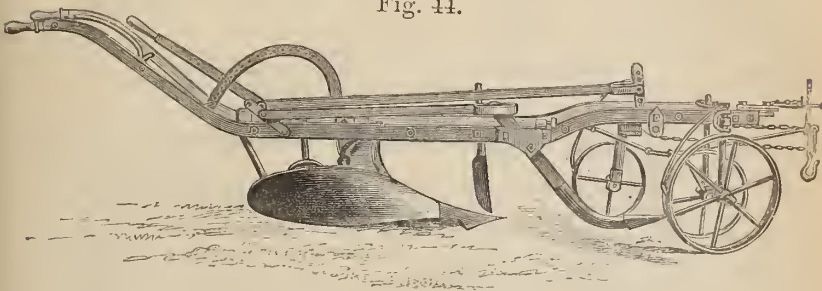


Fig. 45.

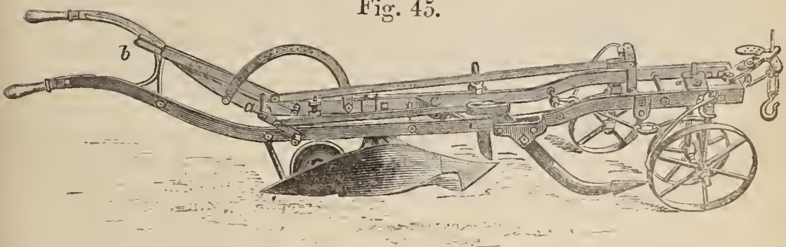
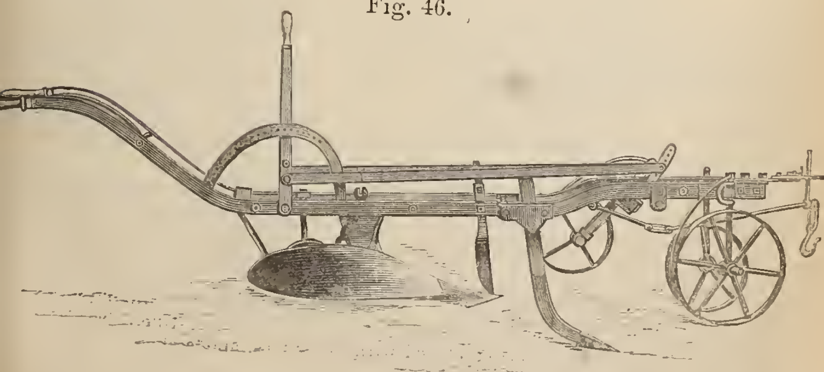


Fig. 46.



Figs. 44, 45, and 46, show the double-furrow plough and subsoiler in different positions.

In Fig. 46 the position of the plough is shown as it would be when the subsoil-tine was operating to a depth of about 6 or 7 inches below the sole of the preceding furrow. The position of the land-wheel nearer the centre of the plough is also shown in this figure.

Fig. 46A.—*Arrangement for securing Rigidity.*

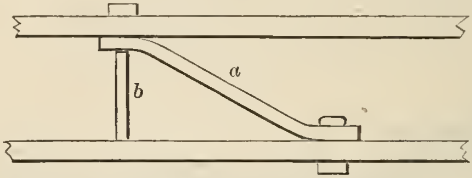
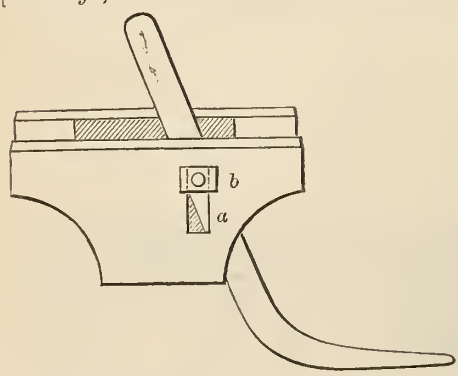


Fig. 46A represents the two beams, and the brace *a* and cross-bar *b*, which ensures rigidity.

In order to convert the double-furrow plough into a subsoiler, the front body must, of course, be removed, and a wrought-iron bracket applied to the beam by bolts and nuts. The bracket is drilled and a strong bolt used, which also passes through holes in the tine, and thus the depth of work is regulated. The bracket is fitted with a set-pin, which can be so adjusted as to support the tine when working at any depth, and thus remove all strain from the connecting-rod and lever. We believe this is the only double-furrow plough fitted with a subsoil-tine in which the lever actuates both the land-wheel and the tine. In reality it is very much the same motion as, or rather the result is similar to, that produced by the action of one lever on the land-wheel and the skid in some cases, and the wheel on the furrow side in others.

W. Ball and Son. No. 1470.—Price, complete, 12*l.* 10*s.*; that is to say, 2*l.* 10*s.* extra for subsoiling parts. The application consists in removing the front body, and substituting a short frame (Fig. 47), which has a vertical slot *a*, in which the screw-pin *b*, for regulating the depth of the tine, works. When in work the tine rests against a backstay in the frame. This was not made sufficiently strong, and gave way. The subsoil-tine can work between 4 and 6 inches in depth before the furrow. The tine is taken out of work by a leverage from the stilts.

Fig. 47.—*Subsoiler and Frame for application to W. Ball and Son's Double-furrow Plough, No.* 1470.



The tine is slightly bent in order to enter the soil as near the centre of the horse-track as possible.

Murray and Co. No. 3505.—This firm showed two implements, in one of which the subsoiler consists of a double tine. The tine-carriage is very strong, being braced with three ribs, and a shoe underneath carries the tine during turning, shown in Fig. 48. *a a a* represent the ribs, and *b* is the shoe. The shoe with or without wings is cast. The exhibitors were, we believe, the first to apply a subsoiler to a double-furrow plough;

the work was very indifferent, and the apparatus clumsy and roughly made, although strong. The tine-stop appeared to be in the wrong place to take the strain of the tine when in work. The work was so indifferent that no observations as to depth were recorded. The price complete is 13*l.*, including 2*l.* for the subsoiler and attachment.

Fig. 48.

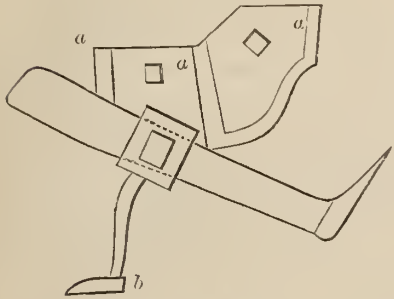
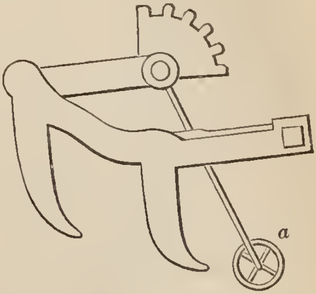


Fig. 49.



Murray. No. 3506.—The stronger implement was broken during the trial; here a double tine attached to a powerful frame was fixed to the plough-beam, and lowered and raised by means of a ratchet wheel and screw lever from stilts; a small friction-wheel assisting in taking a bearing at the land's-end, when the tines are raised. This is shown in Fig. 49, in which *a* represents the friction-wheel. This was a clumsy arrangement.

The price complete, both as a subsoiler and double-furrow plough, is 16*l.* 16*s.*, a formidable figure.

The Prize of 5*l.* was awarded to Corbett and Peele, Perseverance Ironworks, Shrewsbury, for No. 2847.

Class 11.—One-way Ploughs.

Mr. John Davey, of Crofthole, St. Germans, Cornwall, was the only Exhibitor in this and the next Class for Double-furrow One-way Ploughs. One-way or turnwrest ploughs are not much used now save in hilly districts, where it is necessary that the furrows should all be turned in one direction. Mr. Davey's exhibits were therefore quite novelties at Hull; their ingenuity, simplicity, and admirable construction merited all the notice they received. In order to lay the furrows in one direction it is necessary to have two separate mouldboards, one out of work and capable of replacing the other when the plough is travelling in the opposite direction, because the furrows have to be thrown alternately to the right and left of the beam. Mr. Davey effects this by carrying the two mouldboards on a common axle, the connecting arm being so proportioned that, whilst one is in position, the other is carried directly overhead and clear of the beam. The method of reversing is admirably simple, and consists of a lever from the stilts with a crank arm, which is turned over at its end, or rather at the point under the beam, where it couples to a rod from the share, which runs above the sole or slade; the crank arm comes in contact with the inner surface of the mouldboard, and pushes it over into the required position. The same action causing the share, which works on a pivot and has two similar faces, to turn over from one side to the other. This is highly ingenious, and noticeable for its extreme simplicity; there is nothing that can get out of order. The handle of the lever is secured by a hook on the stilts.

The coulter has also to be adjusted from one side of the beam to the other, or rather the cutting edge must assume a different position according as the furrow is to be thrown to the right or left of the beam. This is also made self-acting, and is as simple as the rest. The beam is hollow at the point where the coulter is attached by a pin working in a slot; from the head of the standard a bar passes backwards sufficiently to take a bearing on the front face of the inverted mouldboard holding it in position and keeping it rigid when in work. The reversal of the mouldboard moves the bar, and consequently alters the angle of the coulter; but the most ingenious portion of the whole apparatus is the self-acting lock of the fore-wheels, which makes them suitable for the furrow and land-side alternately, and this is done by having the axle jointed in the centre, so that the wheels can assume different heights at work to suit the furrow and land-side, and are level when the plough is turned. The position of the furrow-wheel in work is secured by the self-acting lock or stop from a central standard, to which it is attached by a hinge, a slight inclination of the plough causes it to fall over either side as required; as soon then as the wheel falls into the furrow, the lock-stop falls over and holds it rigid in its position. It is always more or less difficult to convey to the reader a clear idea of an implement by description. We fear our explanations may lead him to conclude that *The Excelsior* plough is rather an ingenious eccentricity than a simple practical implement; if such is his impression, we must correct it by drawing his attention to the draught as compared with an ordinary plough—a remarkable fact considering the extra weight of the iron mouldboard—and the Judges were unanimous in their approval, both of the mechanism and the quality of work performed. Fig. 50 shows the jointed axle of the fore-wheels and the self-acting lock; *a a* the jointed axle; *b* the self-acting lock.

Fig. 50.

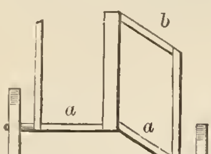
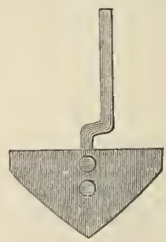


Fig. 51.



I have omitted to notice that Mr. Davey introduced a novelty in his skim coulter, which he places behind, instead of before, the ordinary coulter, and between it and the breast. His argument is that, in this position, the skim coulter, dealing with the edge of a moved or loosened surface, meets with less resistance than when cutting a slice out of the solid ground. The difference between placing the skim before or behind the coulter is an increase or reduction of 23 lbs. in the draught. This skim coulter is double-faced (see Fig. 51), and therefore operates on the furrow as thrown on either side of the beam.

Although one-way ploughing is not either necessary or desirable on level land in ordinary work, it was suggested by one of the Stewards that such an implement would be very useful for working up the headlands of lands cultivated by steam-power. In all cases where a level surface is desirable, such as in preparing land for laying down to grass, the one-way plough will also prove valuable. The cost, including everything, is 8*l.* 7*s.* 6*d.*

Figs. 52 and 53.—*Elevation and Plan of Davey's One-way Single-furrow Plough, No. 660.*

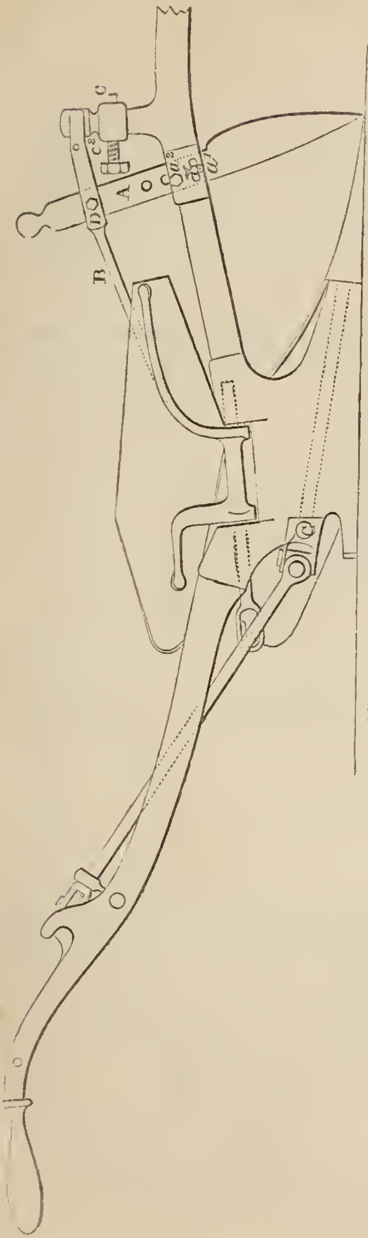


Fig. 52.—Elevation.

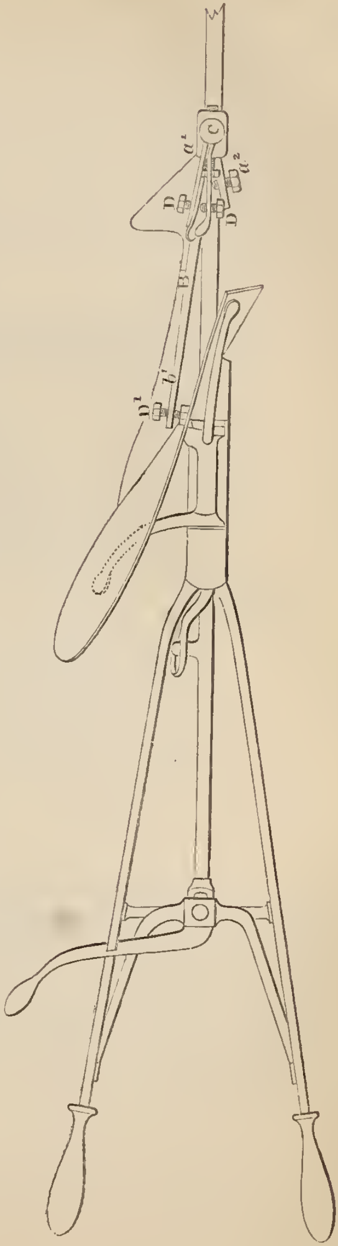


Fig. 53.—Plan.

Fig. 52 shows the plough in elevation seen from the right-hand side of the beam. The position of the elevated mouldboard and its action on the coulter by means of the lever-rod B will be seen.

Fig. 53 is a view of the plough as seen from above.

Fig. 54 is a detached view of the coulter-lever. A is the shank, which passes down through the beam, and is supported by a pin, a^1, through the coulter-boss, and is adjusted for turning from right to left by means of two set screws, a^2. The lever, B, is hung on a stud, C, in front of the coulter. The coulter can be placed in a more or less vertical position by means of a slot. The shank bearing against the set screw, c^2, raises or depresses the coulter-blade as may be required. The end of the lever, b^1, is brought into collision with the breast, and by the revolution of the latter is carried from right to left or *vice versâ*.

Fig. 54.—*View of detached Coulter-lever of Davey's One-way Single-furrow Plough, No.* 660.

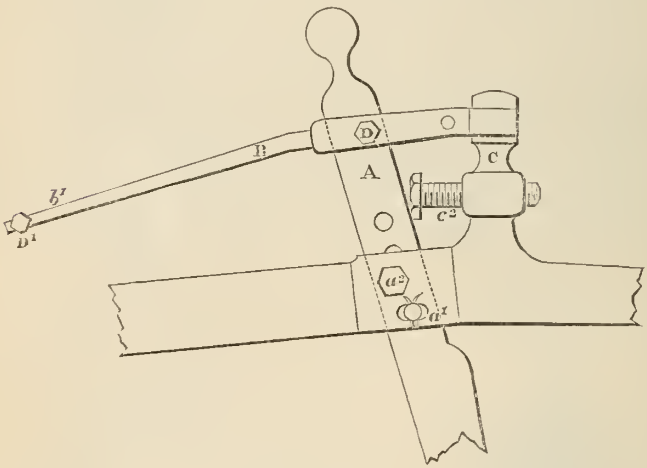


Fig. 55 shows the manner in which the mouldboards are reversed, and that in which the share-shaft is connected with the leverage and universal joint. This is by the pin, G, which is better shown at Fig. 56, p. 570, giving a plan of share and share-shaft.

Fig. 57, p. 570, is a view of the coulter, lever, &c. The lettering will be understood by reference to Fig. 54.

Fig. 58, p. 570, is a longitudinal section of the beam and coulter-boss, with the set screws, &c.

Fig. 59, p. 570, is an elevation of the share and share-shaft.

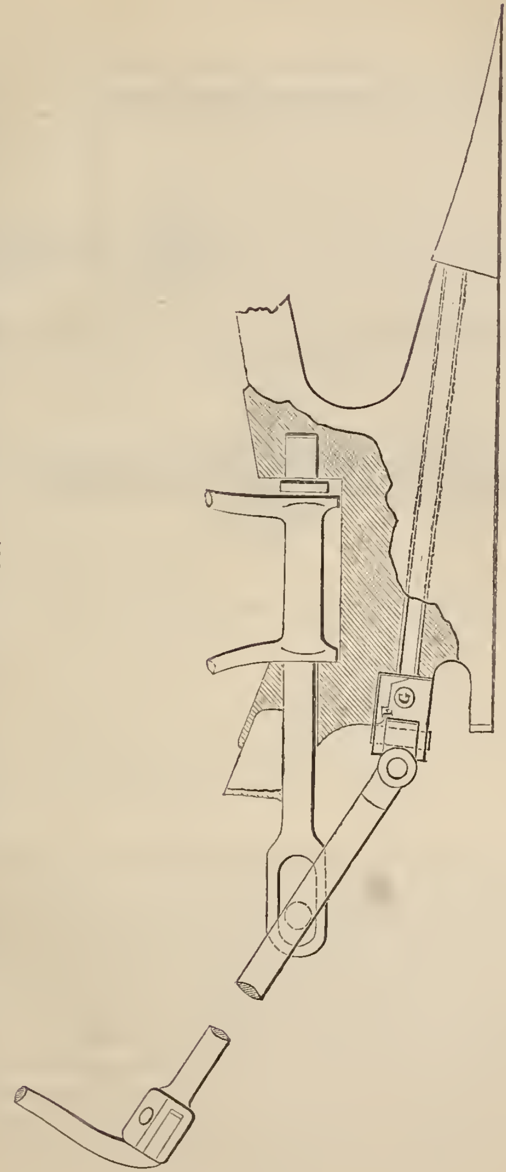


Fig. 55.—*Mode of Reversing the Mouldboards in Davey's One-way Single-furrow Plough,* No. 660.

Fig. 56.—*View of the Share and Share-shaft of Davey's One-way Single-furrow Plough, No.* 660.

Fig. 57.—*View of Coulter, Lever, &c.*

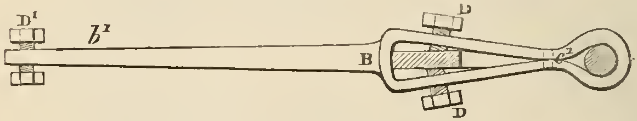


Fig. 58.—*Longitudinal Section of the Beam, with the Coulter-boss and Set Screws, &c.*

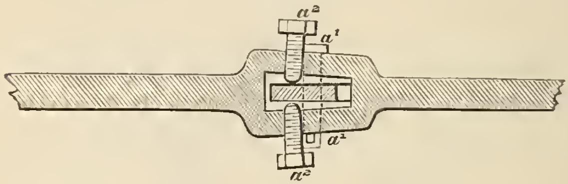
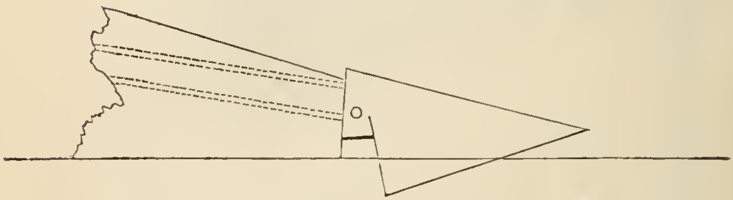


Fig. 59.—*Elevation of Share and Share-shaft.*

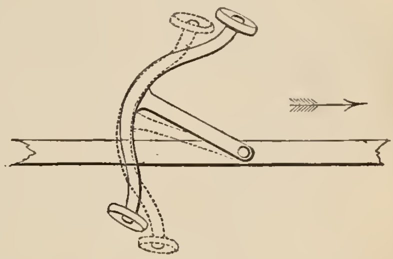


Class XII.—Double-furrow One-way Plough.

Mr. John Davey was here again the only exhibitor. His "Climax" double-furrow, turn-wrest, or one-way plough (No. 661) merits, however, our praise as a highly ingenious, well-constructed implement, which would be very hard to beat. To effect double-furrow one-way ploughing it is necessary to have four bodies—two in work and the others suspended; to make these change places with ease, to apply simple mechanical arrangements for raising the ploughs out of work, and turning the plough at the headlands, and to lock the fore-wheel in work, are points upon which great labour and ingenuity have been expended, and the result is one of the most perfect implements we have ever seen. We trust that, by the help of our illustrations, we shall be able to convey some idea of the plough :—

The frame carrying the mouldboards revolves upon a central bearing, which, being hollow, allows of a rod passing through it, terminating in a short chain, to the vertical shaft of the fore-wheel carriage. The other end of this rod is connected, by another short chain, with a movable wheel under the stilts, which during work occupies a forward position. This wheel is also attached to a spring which acts as a lock upon the frame. The workman, by means of a lever-handle attached to the standard of this wheel, brings it into a vertical position, in which it is held by two small spuds or spikes. By this movement the frame is set free to revolve, and the fore part of the plough is raised clear of the ground. The frame is turned round by the workman, and, being well balanced, this is effected with the greatest ease. The stop on the furrow-wheel is turned over by the same movement, being attached to the frame by a small chain, and the fore-wheels assume a level condition. And now comes into play the most ingenious part of the whole, viz. the self-acting shoe, which, as soon as the ploughs are raised out of the ground, drops down by its own weight, and takes a bearing just about in the centre of the machine. As soon as the ploughs are reversed the workman slightly raises the handles, thereby setting free the hind-wheel, which, acted on by the spring and the strain from the rod, flies back to its position under the beam. The beam assumes its parallel form, and the ploughs would be upon the ground but for the self-acting shoe, on which and the fore-wheels the whole frame is carried clear of the ground. The shoe, formed of a small disc wheel bolted to its arm, revolves, consequently the plough rides round, as it were, on a pivot; and as the share enters the ground the shoe is pushed back, and remains clear of the soil behind the second mouldboard. Fig. 60 shows the position of the shoe during work; it will be evident that, as soon as the frame is raised from the ground, the shoe will come forward and take a bearing on the ground. This I have endeavoured to show by the dotted lines. The arm of the shoe is attached to the central bearings.

Fig. 60.



The plough is made entirely of wrought or malleable iron. The horse-track is sufficiently wide, there being 16 inches from the slade to the widest part of the mouldboard.

The hind-wheel is regulated by an adjusting screw. The right-hand beam is adjusted by means of a slot in the transverse piece, so that the width of furrow admits of considerable variation. It should be noticed that on these transverse pieces at the fore end of the beam are two studs for the purpose of locking the frames on to the central beam; and, to further render it impossible for any sudden shock to sever the connection, a key or stud is applied to the hind transverse piece, and acted upon by a spiral spring secured to the central beam by a collar or set screw. This will be best understood by reference to the plan of the frame, Fig. 66. It will be seen from this arrangement that the tension of draught increases the rigidity of the frame. The work done was of a superior character, and, considering the extra weight of the plough, the draught was not excessive.

It is hoped that the figures on p. 572 will convey a clearer impression of the nature and construction of the double-furrow turn-wrest plough than is possible from description only.

Fig. 61 shows the position of the back wheel and leverage during work. The rod A, passing through the central tube, indicated by dotted lines, is connected with the fore-carriage by a bell trap lever B. The hind end of the

Figs. 61–66.—*Illustrations of Davey's One-way Double-furrow Plough, No.* 661.

Fig. 61.

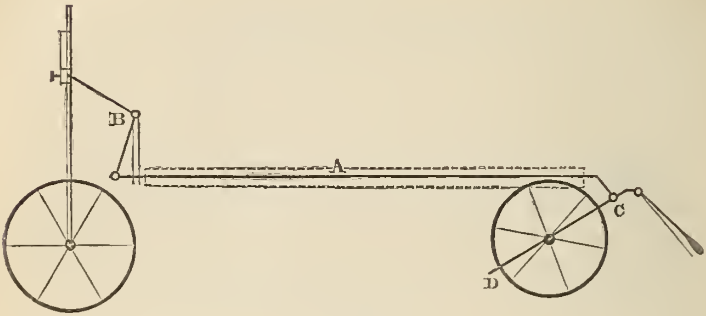


Fig. 62.

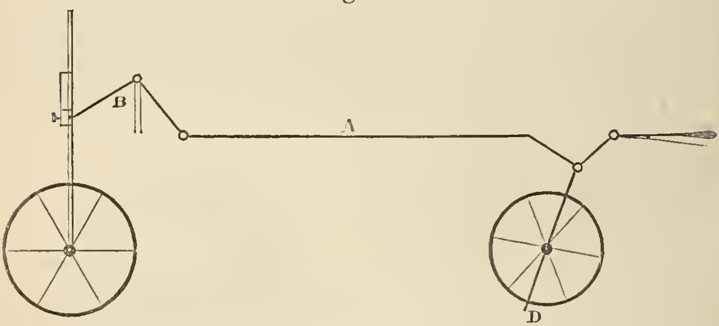


Fig. 63.

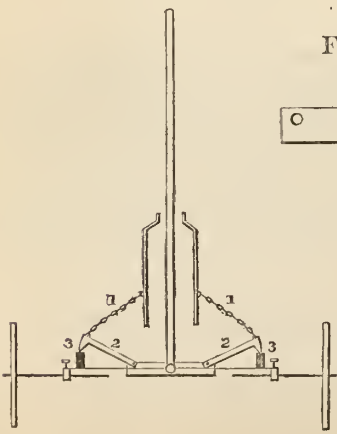


Fig. 65.

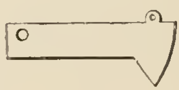
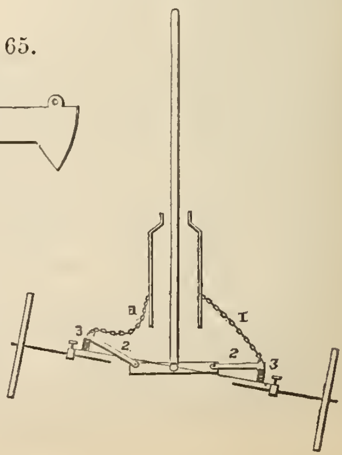


Fig. 64.



rod is attached to the wheel-arm C, the handle of which is slightly raised by the ploughman, and this brings the spikes, D, in collision with the ground and arrests the progress of the plough; all further labour is taken from the ploughman by the onward action of the horses, the plough is raised clear of the ground, and assumes the position shown at Fig. 62.

When the frame is thus elevated, the locking apparatus is acted upon for unlocking or removing the rigidity of the wheels. This is effected by the chains 1, 1, shown in Figs. 63 and 64, which are hooked to the head of the plough. As the frame is raised, both locks, shown at 2, 2, are drawn up from the studs, 3, 3; by a slight elevation of the stilts, the hold of the ground by the spikes of the hind-wheel is released; the wheel springs forward by the tension of the rod, as before described, and the frame is again let down for the next furrow. As it descends, the locks fall into their places on the studs, the wheels are immediately made rigid and adjust the depth of furrow required. Thus the locking arrangement is perfectly self-acting, viz. self-locking, self-unlocking, and self-adjusting. Of course the under part of the shaft, or axle, of the fore-wheel is jointed.

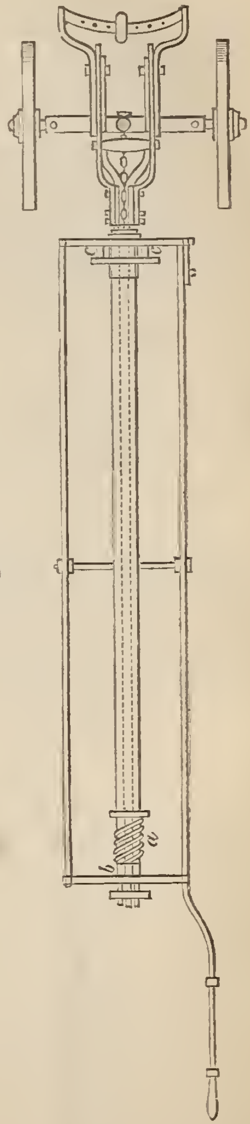


Fig. 66.

Fig. 63 shows the lock, as at the headlands, unlocked, and held to chains clear of the studs.

Fig. 64 shows the lock when the plough is let down in working position, and the wheels are made rigid by the lock falling on the stud, each lock acting at alternate headlands.

Fig. 65 shows the form of the lock.

In Fig. 66 a plan is given of the central tube, springs, and studs, which will assist the reader to understand how the plough can be held rigid in work: *a*, the spiral springs; *b*, the key or studs; *c*, the studs.

For the results of the Dynamometer Trials see Table II., facing p. 539.

The prize of 5*l.* was awarded to this plough.

Class 13.—Subsection G. Double Mouldboards or Ridging Ploughs.

The conditions attaching to this class were that the plough should not exceed $2\frac{1}{2}$ cwt., and should be tested in ridging up land from the flat, moulding up potatoes, and opening water furrows after ploughing. I was unavoidably absent during these trials, and therefore do not know the arrangements as to the different tests;

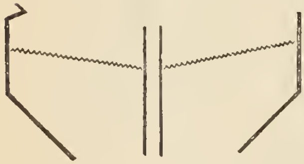
certainly there were no potatoes provided for earthing-up; but the Judges were able to satisfy themselves as to the merits of the different ploughs, by the way they raised ridges from the flat. There were half-a-dozen competitors. A table was made, and the following particulars were kindly supplied by that experienced Judge, Mr. J. Hemsley.

Plot 1. *Corbett and Peele.* No. 2848.—Price 4*l.* 17*s.* 6*d.*, including two pairs of mouldboards and three points; marking-iron, 8*s.* 6*d.* extra. Strong-land boards, 3 feet 8½ inches long; light-land boards, 3 feet 4½ inches; length of sole or slade, 2 feet 7 inches; expansion of wings from 18 to 28 inches; has two front wheels, diameter 17 inches. The width of these wheels apart can be altered by a slot and set screw. The beam is 2½ inches by ⅞ inch.

The plough was not steady in work, and the ridges were indifferently made.

Plot 2. *Murray and Co.* No. 3507.—Price 5*l.* 5*s.*; marker, 7*s.* 6*d.* extra; steel breasts, 12*s.* 6*d.* extra; length of sole, 3 feet 11 inches; beam, 2½ inches by ⅞ inch, where the body is attached, tapering to 1⅞ by ¾ inch; whole length, 11 feet 9 inches. The form of the mouldboards is peculiar; the breasts, instead of being convex, are angular, and present from behind the appearance shown in Fig. 67.

Fig. 67.

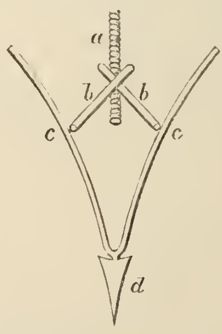


The mouldboards, including point, are 4 ft. 4½ inches long; the point being 11 inches. The width of the mouldboards is altered by means of a screw tapped into the beam, a clumsy arrangement, liable to get out of order after a time. The plough works on the swing principle, and there is no provision for applying wheels; this was a great drawback in the opinion of the Judges, who, nevertheless, were so pleased with the performance, steadiness in work, and excellence of construction, that they gave the plough a high commendation, which, as there was only one prize, brings it into second place.

Plot No. 3 was occupied by *Mellard's Plough*, No. 4321.—Price 4*l.* 7*s.* 6*d.*; 15*s.* extra, if with steel instead of iron mouldboards. The latter was 2 feet

Fig. 68.

Fig. 69.



a. Screw.
b b. Arms, the angles of which are adjustable by the screw.
c c. Wings.
d. Point.

$8\frac{1}{2}$ inches long, exclusive of the point, which is 10 inches; giving a total length of 3 feet $6\frac{1}{2}$ inches; the beam, 3 inches by $\frac{3}{4}$ inch; slade, 3 feet 3 inches long; whole length of plough, 10 feet. The mouldboards expand from 21 to 25 inches. No marker was supplied; work very unsteady.

Plot No. 4. *Hunt.* No. 1634.—Price, 4*l.* 7*s.* 6*d.*; marker, 7*s.* 6*d.* extra. Length of mouldboard, 2 feet 11 inches; front, 13 inches; total, 4 feet. Slade, 3 feet 1 inch; diameter of wheels, 10 inches. The mouldboards expand from 13 to 25 inches, and can be altered whilst the plough is in motion. This is done by means of an endless screw acting upon two wrought-iron arms shown in Fig. 69. The action will be understood by a glance at Figs. 68 and 69.

This implement is ingenious rather than particularly useful, as the great object of such an operation as ridging is to obtain parallel lines for the reception of the seed; and save in the case of earthing-up potatoes, and that very rarely, one cannot imagine the necessity arising for any alteration during work.

The plough head or body is trussed into the beam (*vide* Fig. 68). Like all Mr. Hunt's implements which competed at Hull, the workmanship is very good, but the Judges considered the implement not sufficiently strong for all sorts of land.

Plot No. 5. *Ball and Son.* No. 1472.—Price, 4*l.* 10*s.*, including cast-steel breasts, marker, and one point. This is a reasonable, well-made plough; and as it made the best work, the Judges considered it fairly entitled to the prize, especially as it made the best water furrow. For this purpose a particular point was used—namely, $4\frac{1}{2}$ inches wide in front and 9 inches across the wings. The sole measures 3 feet; the length of the mouldboard, exclusive of the point, is 3 feet 2 inches; depth, 12 inches. It has two front wheels, 17 inches diameter, 16 inches apart, and not alterable. The mouldboards expand from 15 to 24 inches; the stays for the mouldboards are fixed direct through the plough-head; they are a little too forward in position, but secure rigidity. The ridge was well formed, the soil being brought well up along the face of the breast; the width of the point, at its widest part during the operation, was 7 inches.

E. Page and Co. No. 2632.—Entered, but did not come to trial.

The prize of 5*l.* was awarded to William Ball and Son, Rothwell, Kettering, for No. 1472; and G. W. Murray and Co., of Banff, N.B., were highly commended for No. 3507.

Class 14.—Paring Ploughs.

There were three entries. Messrs. Hill and Smith's excellent implement, having none of the ordinary arrangements of a plough, was regarded as ineligible for competition, and as having been entered in a wrong class, being in all respects a broadshare. This implement has been before the public for many years, and its merits are well known. The frame is jointed, that portion carrying the two broadshare bodies is raised out of work by pressure on the handles. The two blades cut a width of 2 feet 1 inch. The depth is regulated by raising or lowering the wheel arms. The shares have steel points welded in between two pieces of iron, and the wearing of the iron tends to keep the steel bright. The frames made of $\frac{5}{8} \times \frac{2}{3}$ wrought-iron plates, and the cost, with grubbing coulters, is 7*l.* This implement is open to the same objection as other broadshares, viz., that whilst effectually cutting the surface, the severed soil is not turned over, but left so exposed that the first shower causes vegetation to start afresh, whereas the paring plough proper not only cuts off the surface, but turns it over, or leaves it so light that the rain passes through it without remaining sufficiently long to start vegetation.

Ball and Son. No. 1473.—The share or cutting surface is 1 foot 10 inches long by 16 inches wide, and is provided with a small cutting-edge, 1½ by 4 inches, against the land-side and immediately below a wheel coulter, and ought therefore to secure a clean cut. The blade is steel in a cast-iron socket. The price of the blade is 9*s*. The plough is fitted with a common mouldboard. The work was not so well done as might have been expected.

W. Hunt. No. 1633.—The peculiarity in this plough consists in the mouldboard, which is concave in the centre, and continued to a flat cutting edge. The share cuts 10 inches and the mouldboard 8 inches, making a total width disturbed of 18 inches. The work was well done, but the objection to this arrangement is the cost of renewing the mouldboard and the difficulty of sharpening the cutting edge. As in the other ploughs made by Mr. Hunt the pitch of the share can be altered by an eccentric acting on the slade. A small cutting knife is attached to the hinder portion of the slade, which is adjustable. The only advantage of this, as far as we could judge, was to give a sort of purchase to the hinder part of the plough, and so increase steadiness in work at some increase of draught.

Fig. 70.

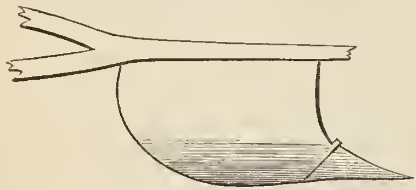
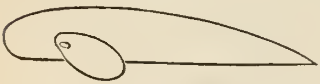


Fig. 71.



The Judges, whilst awarding Mr. Hunt the prize of 5*l.*, considered the class an indifferent exhibition.

Class 15.—For the best Plough for leaving the Furrow Slice pulverized.

In this Class there were four entries, three only came to trial, Lewis and Co. being here as elsewhere absent.

Mellard's Trent Foundry. No. 4322.—This is the American disc plough, which, though competing at a Royal trial for the first time,* has been used in this country for some years, and has attained considerable notoriety. It was introduced shortly before the Manchester meeting in 1869, and one was exhibited at work near the Show ground. The nature of the implement, and the revolving disc in place of the hinder part of the shell board, its peculiar feature, will be best understood by reference to the subjoined illustrations. The axle of the disc is carried in a box or collar attached to the beam. The weight of the soil causes the disc to revolve. That the principle is correct will be seen by a comparison of the draught of this and the other competing ploughs, and the reason for the lightness is obvious, viz., the absence of friction on the mouldboard, and it is the motion to which the soil is subject,

* A Silver Medal was awarded at Wolverhampton, in 1871, to Mellard's Trent Foundry Co., for "the adaptation of the principle of the rotating disc mouldboard, &c."—Ed.

as well as the abrupt character of the front portion of the mouldboard, and the nearly vertical position of the disc which effects the breaking of the soil. When the latter is dry and tolerably light the effect is very perfect, but when the soil is damp and tough very little effect was produced. One can imagine great advantage in preparing vetch land for turnips, or where turnips have

Figs. 72–75.—*American Disc Plough exhibited by Mellard's Trent Foundry Company, No.* 4322.

Fig. 72.

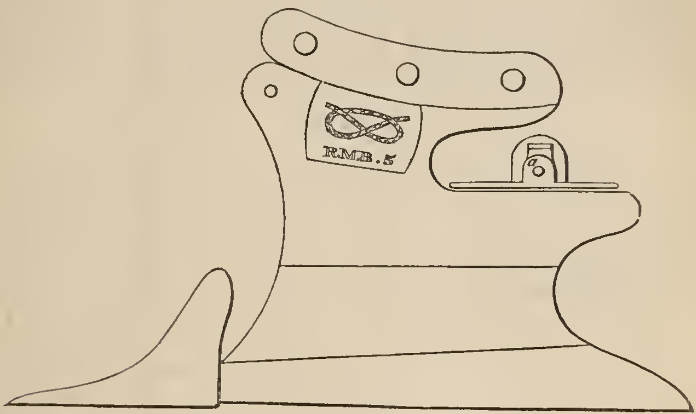


Fig. 73.

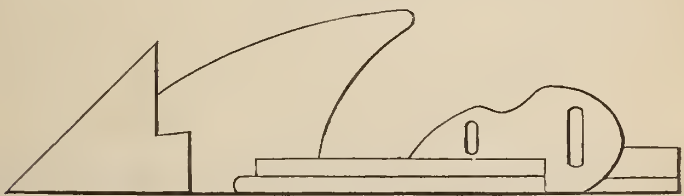


Fig. 74.

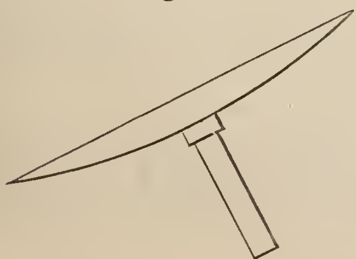


Fig. 75.

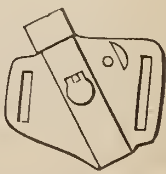


Fig. 72. Shows an elevation of the body, with the socket for shaft of disc, marked *a*.
„ 73. Plan of share-front board, and castings to receive the disc supports.
„ 74. Disc and arm.
„ 75. Castings on body to receive arm of disc.

been consumed on the land late in the spring to be followed by barley, as in such cases a seed furrow is obtained by one operation. Again, for stubble ploughing on some descriptions of land, the disc plough may be usefully employed. The price, with iron disc, is 5*l.* 15*s.*; 10*s.* extra for steel face, which, however, is not necessary or recommended. The fact is that a very smooth and polished face to the disc is hardly an advantage, since a slight amount of friction ensures the revolutions of the disc.

Messrs. Corbett and Peele. No. 2849.—This implement has two peculiarities, first in the under side of the wings of mouldboard being serrated, an arrangement which it is thought helps to break lumps that fall down from the furrow, but which in reality has a very infinitesimal effect; and, secondly, in the presence of a revolving circular rake, the arm of which works in a ratchet so as to allow of considerable alteration of the angle. If the object were merely to make an equable surface the circular harrow might answer

Fig. 76.

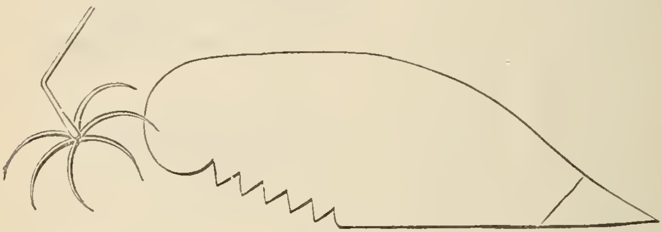
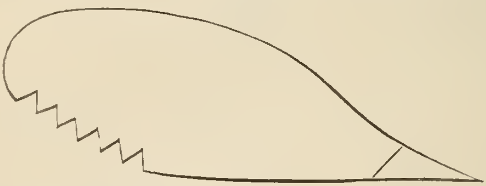


Fig. 77.



very well, but in the case in question the coulter and mouldboard are the important elements, and these are very much like any ordinary plough, consequently the body of the furrow is not sufficiently pulverized, and the Judges could see any advantage in "The Little Wonder" as it is called, combing the surface, but rather an objection for many purposes, inasmuch as the fine top to some extent, at any rate, interferes with the action of the air on the soil beneath. The Judges considered that the implement hardly came within the terms of the offered prize.

W. Ball and Son. No. 1474.—This is an ordinary plough, with digging breasts of cast iron, fitted with a wrought-iron steeled cutter standing out 5 inches from the breast—the object being to cut the furrow horizontally as it passes along the breast. The beam is fitted with double coulters placed on opposite sides. The Judges considered this implement a capital digger, laying up the soil in rough lumps, but not a pulverizer. The price, including cutter, was 5*l.*

The Prize of 5*l.* was awarded to Mellard's Trent Foundry (Limited), Rugeley, Staffordshire, for the American Disc Plough, No. 4322.

Class 16.—Miscellaneous: for the Best Plough not qualified to compete in any of the foregoing Classes.

Only one implement out of three entered came to trial, that of Murray and Co. (No. 3508). The object of this implement was to effect a description of trench-ploughing, throwing manure, &c., with from 2 to 4 inches of the surface soil into the trench made by the previous furrow, and turning another furrow on the top of it. The implement was so unsteady, and the work so irregular, that the Judges stopped the trial and withheld the prize.

Section 2. Harrows.—Classes 17–19.

In the ten classes under this section, there were no fewer than seventy-one entries; several, however, did not come to trial. The fallow portion of Field No. 1 was set apart for harrows, cultivators, and rollers. No dynamometer tests were applied, the difference in quality of work and mechanism being considered rather than draught, which could not vary much, and was so inconsiderable as to be difficult to register. With one exception, that of the Second Prize in Class 19 (Chisel Harrows), V-shaped teeth were employed in every prize implement, and it does not require much demonstration to show the correctness of this form. The object of harrowing, pure and simple, is either to break up lumps of soil already on, or near the surface, or to bury seed placed in the soil. In either case the wedge-shaped face of the V-tooth will insinuate itself more readily into the centre of a clod, and with less consumption of power than a square surface. The form of the frame and the method of attaching the teeth varied considerably. In the majority of cases the zigzag pattern first made by Messrs. Saunders and Williams, of Bedford, was adhered to. Probably there is no better, because, owing to the distribution of weight equally over the whole surface, each tine presses on the ground with uniform weight; and secondly, because the heads of the teeth are made to hold together the bars of the framework. I confess a great liking theoretically for the arrangement first patented by Seaman, and now used by Larkworthy and others. The principal feature in this arrangement consists in the zigzag beams being held in place by hollow tubes, with collars through which and the teeth a ½-inch rod passes, terminating in a bolt-head on one side, and a nut on the other. The teeth are made with shoulder pieces above and below, which clip the beams, and are held in place by the rod. There is great simplicity in this arrangement, and each section of the harrows is held by 5 nuts instead of 20, as would be the case according to the ordinary method of fixing by screw-head, teeth, and nuts. The following illustrations exactly describe the mechanism. This system was

Figs. 78 and 79.—*Illustrations of the collar and tube arrangement of Teeth and Beams in Harrows.*

Fig. 78.

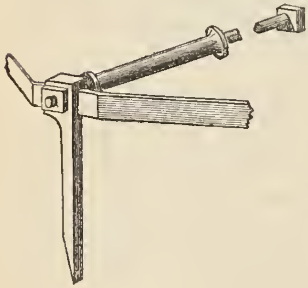


Fig. 79.

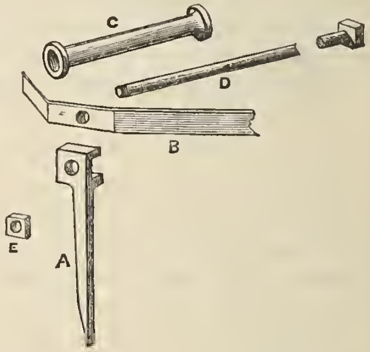


Fig. 78 is a view of one of the teeth and parts of the beam, in order to show the joint; and Fig. 79 is the same as Fig. 78, but with the different parts detached, so as to show each separately. It will be seen by Fig. 79 that the tooth A is formed with a grooved head, which fits on the side of the beam B, and clips it tightly, thereby throwing the strain on the tooth directly on the beam; the bolt D which passes through both, merely serving to maintain the different parts in their relative position to each other. C is a tube or collar through which the bolt D, which secures each row of teeth, passes, and which serves to maintain the harrow beams at their proper distance from each other; the whole when put together and the bolt tightened up by the nut E, being almost as rigid as if in one piece.

adopted by Messrs. Larkworthy, and Cambridge and Parham; and as neither were noticed by the Judges, it may be concluded that the work done by them was not as satisfactory as that done by others.* Referring to the Judges' log-book, I find that whilst W. Ashton's heavy harrows in Class 4 were credited with 800 marks, those of Messrs. Larkworthy and Co. reached only 700, and Messrs. Cambridge and Parham were 600. Confining our attention to the mechanical qualities, the first and second prize implements in Class 18 will be found credited with 250 and 240 marks respectively, whilst Larkworthy's and Parham's were valued at 200; so that it is clear that the Engineers considered this arrangement the less perfect.

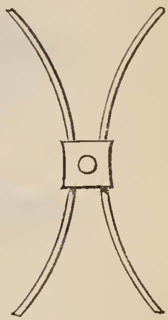
* Since the above was written I have learnt that the Judges were unanimous in their approval of this principle, especially as regards the plan of securing the fixture of the tines.

The points of merit given for these implements may here be noticed.

	Perfection.
Weight	50
Price	100
Mechanical qualities—strength (Engineers' opinion)	300
Simplicity (Farmer Judges' opinion)	100
Economy in power and draught	250
Quality of work done	200
	1000

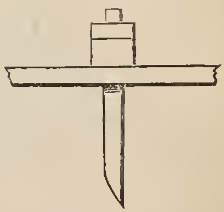
Thomas Hunter, of Maybole, Ayrshire, exhibited a novel arrangement of framework in the classes for light and heavy harrows. The tines are driven into a socket or square box, which also holds the frame bars, as shown in Fig. 80. The four sections of which this harrow is composed cover about 10 feet, and cost, according to weight, from 4*l.* to 4*l.* 15*s.* The ends are made with angle-iron, and the only bolts required are those connecting the frame with the end bars. This harrow lacks finish, but is strong in construction, and cheap; and, provided the tines do not give way, ought to be serviceable.

Fig. 80.



Messrs. Hill and Smith, of Brierley Hill, Staffordshire, showed a strong useful harrow of two descriptions, for light and heavy work. No. 2076 was furnished with handles of wrought iron, covering 10 feet of ground, and costing 5*l.* 5*s.* This is a very serviceable implement; the liability of the nuts to shake off during work is provided for by a lock button on the top (Fig. 81).

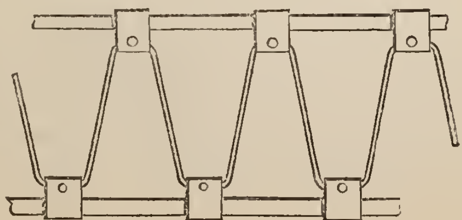
Fig. 81.



Messrs. Murray and Co., of Banff, showed a novel form of harrow in which the tines were secured in a somewhat similar manner to those of T. Hunter's, the beams being held in place by straps which get a bearing in the sockets. The following illustration (Fig. 82) will suffice to explain. Price, 4*l.* 4*s.*

In *Mr. Hunt's* harrow, which gained the second prize in the class for light harrows, the cross-bars, instead of being straight, are so constructed that each alternate tooth is in advance of its neighbour; in this way the teeth are more completely separated, and there is less liability to clog. The method of fitting in the teeth is also deserving of notice. The top bar is tapped, and the tooth, after passing through the bottom bar, is screwed into it—a nut at

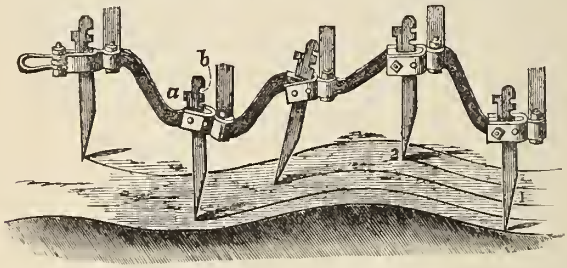
Fig. 82.



the top further completing the attachment. It is evident that should the nut shake off, as is not unfrequently the case, there is still the thread in the upper beam to depend upon. The price is rather high, viz. 5*l.* 15*s.*

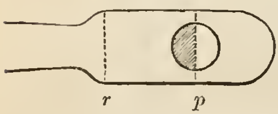
Benjamin Reid and Co., of the Bon Accord Works, Aberdeen, gained the second prize for heavy harrows (No. 2944). The peculiarity of the "Challenge" harrows consists in their being worked either rigid or jointed, to suit inequalities of surface, ridges, &c. The beams are made in joints, and the pin connecting these joints serves at once as hinge and also as holder for the tines. This will be better understood by reference to the illustration, which shows a portion of the frame in a jointed condition. *a* shows the wedge; *b*, the recesses or slots on the edge of the tine. Nos. 1 and 2 teeth are shown rigid, the others are loose.

Fig. 83.—*Section of B. Reid and Co.'s Heavy Harrows, No.* 2944.



The pin is of steel, and the half of its diameter projects into the recess into which the tine is placed. Thus in Fig. 84, *r* is the recess, *p* is the pin, the half shown by the shaded lines projecting into the recess. The tines are made with recesses or slots on the edge to fit on to this half of the pin, and when the wedge is driven up tight on the other side of the tine, between it and the recess in the joint, the tine is held tightly in position.

Fig. 84.

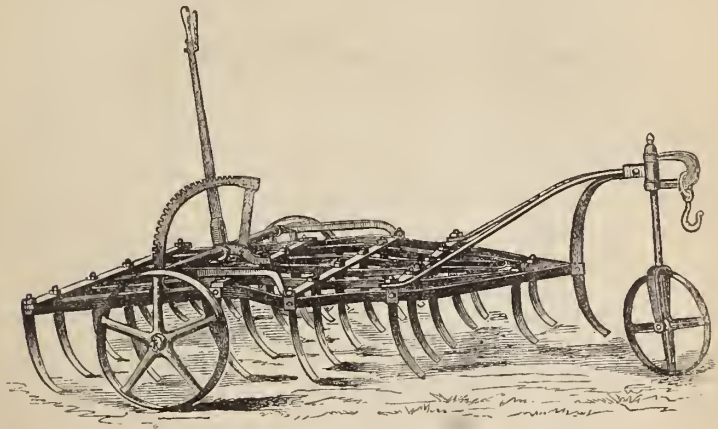


There are, as will be seen, a number of slots or notches on the edge of the tines, so that the position of the tines in reference to the frame can be altered at pleasure. In each joint or hinge, besides the hole for the hinge pin, there is another hole, and by passing a bolt or pin through these holes the beams are made rigid, and the jointed character entirely done away with. It will be seen by Fig. 83 that the two right-hand tines marked 1 and 2 are kept in a vertical position, owing to the bolts making the beams rigid, whilst the next two are flexible by the bolts being removed. There is much ingenuity in this novel arrangement. The harrow worked very well, and proved its suitableness for unlevel surfaces.

The distinction between a harrow and cultivator is difficult to define. Formerly it was held that every tool with curved tines was a cultivator, and this was a tolerably sound definition, for it is quite clear that a curved tooth is meant to enter the soil and deal with matter beneath the surface. Now, however, the Chisel and Duck-tooth Harrows, though coming within the list of cultivators, according to the above definition, are classed as harrows. "A rose by any other name would be as sweet," and, whether they are correctly described or no, there is no doubt of the great value of these implements. And we need only contrast the admirable specimens shown by Mr. W. Ashton, of Horncastle, with the old wooden Drag Harrow, to be convinced of their value and economy. It frequently happens that land which has been ploughed some little time has become consolidated to such an extent that straight-toothed harrows fail to lighten up the soil sufficiently for a healthy seed-bed; for such a case the Chisel Harrow is invaluable. On light soils it acts as a cultivator, and succeeds admirably, provided the land is not very dirty; the only difference between the Chisel and Duckfoot Harrow is in the termination of the tines, the one being square, the other rather pointed in the centre.

Mr. W. Ashton was highly successful, taking first prizes in three classes—his chisel harrow being specially commendable for the ease and rapidity with

Fig. 85.—*Mr. W. Ashton's Chisel Harrow, No.* 2804.



which the depth can be altered by ½-inch increments. The frame is carried on wheels, having a crank axle; a lever handle from the axle carries a spring catch working in a notched ratchet bow. Thus the tines can be worked from ½ inch to a foot deep, or taken up out of ground altogether, and the movement is instantaneous. The foregoing sketch (Fig. 85) shows the implement. The frame combines strength with lightness, and is equally adapted either for duck-feet or chisel teeth. The price of this implement is 11*l.* 11s.

The second prize for chisel harrows was awarded to Messrs. Sharman and Ladbury's oscillating diagonal harrows (No. 4358).—This is a strong serviceable implement, but the front of the tines being square instead of V-shaped, appeared to me objectionable, increasing the resistance of the soil. The teeth are 9 inches long beneath the frame, to which they are attached by square shoulders, the end being topped and nutted. The frame is 6 feet wide and carries 25 teeth; the oscillating motion is very satisfactory; the work done was excellent. Price, 6*l.*

Awards in Classes 17, 18, and 19.

Class 17.—*Light Harrows.*

2801.—First Prize of 10*l.* to William Ashton, of Boston Row, Horncastle.

1640.—Second Prize of 5*l.* to William Hunt, of Leicester.

Class 18.—*Heavy Harrows.*

2803.—First Prize of 10*l.* to William Ashton, of Boston Row, Horncastle.

2944.—Second Prize of 5*l.* to Benjamin Reid and Co., of Bon Accord Works, Aberdeen.

Class 19.—*Chisel Harrows.*

2804.—First Prize of 10*l.* to William Ashton, of Boston Row, Horncastle.

4358.—Second Prize of 5*l.* to Messrs. Sharman and Lodbury, of Melton Mowbray.

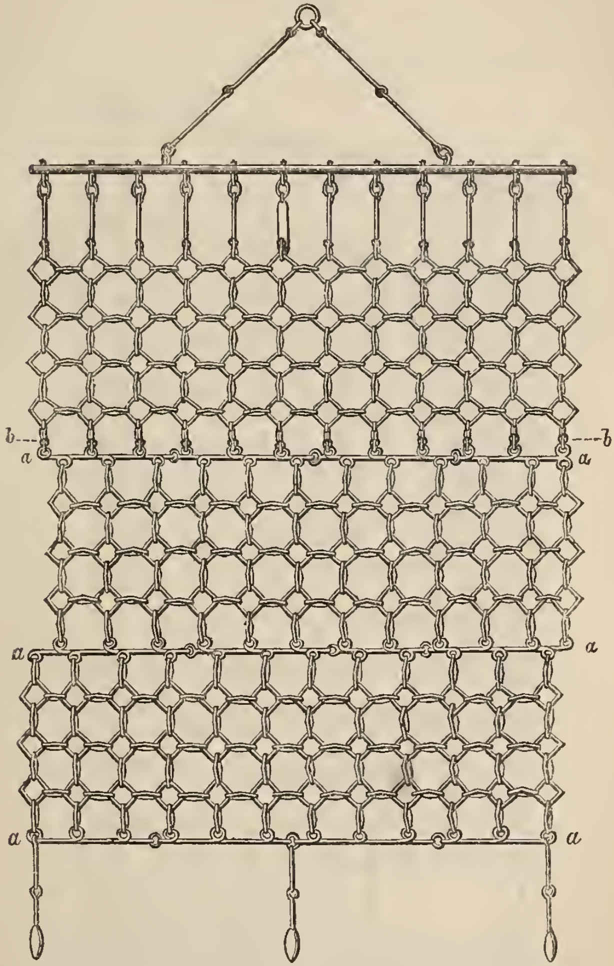
468.—Highly commended, Charles Clay, Wakefield.

Class 20.—For the best Chain Harrow.

The entries in this class were not numerous. Messrs. Cambridge and Parham, of Bristol, maintained their position in reference to these useful implements, which I believe were first introduced by the late Mr. Cambridge, or greatly improved by him. At the present day there are two descriptions of chain harrows, viz., the chain harrow proper, in which the operating parts are the under surfaces of the links only, or aided by disc wheels between the links; and a combination of tine and chain, which is found more valuable in reducing rough surfaces, and scratching over hide-bound grass land, but is not so well adapted for the same business as the old brush harrow, inasmuch as the tines collect the vegetable matter, and are not easily cleaned; both are admirable for their particular work.

The harrow (No. 736) with which *Messrs. Cambridge and Parham* gained the prize is an improvement on the original chain harrow in the following respects. The earlier implements were made with solid stretchers, which prevented the chains following inequalities of surface; consequently portions of the work where the ground was unlevel would be missed. Mr. W. C. Cambridge invented a "jointed" or "flexible" spreader, shown at *a a a* in the plan, Fig. 86. The harrow is made in three parts, so connected by the said stretchers that no 2 rows of links can follow in the same track, and no inch of surface is left unworked. This appears to be a point of great merit. The dividing hooks which connect the top part of the harrow to the middle portion are of great service, inasmuch as the harrow can be reduced in size by removing the top part altogether, and bringing back the whipple-tree to the spreader; and as the tail part being more constantly on the ground wears out first this can be renewed and joined on without a blacksmith's assistance. The harrow is 8 feet 6 inches long by 7 feet 6 inches wide. The links are of square iron, as the angular form is most effective. The front portion is of $\frac{7}{16}$ iron, and the middle and back portion of $\frac{3}{8}$. Price, 4*l.* 15*s.*

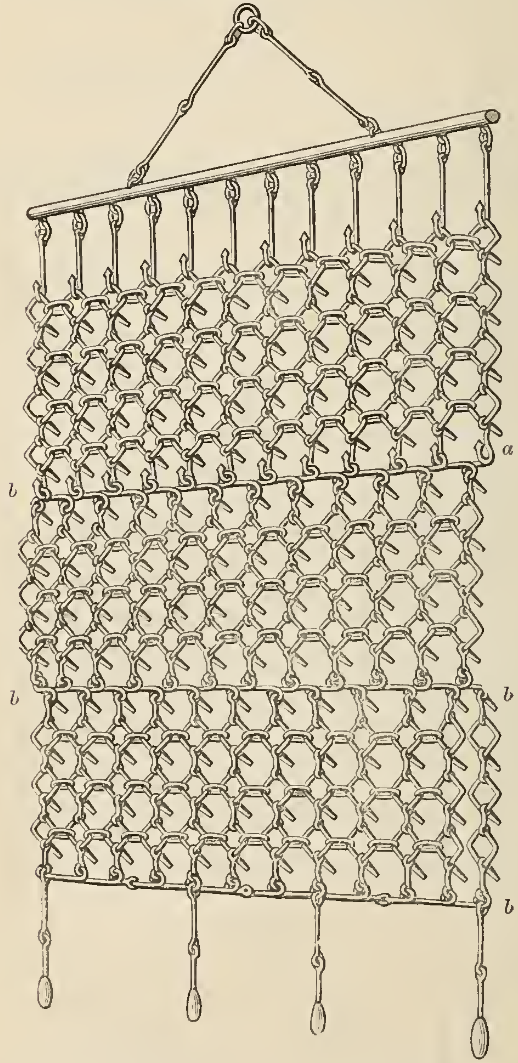
Fig. 86.—*Messrs. Cambridge and Parham's Chain Harrow, with Jointed Flexible Expanding Bars, No.* 736.



a, a, a. Jointed spreaders. *b, b.* Dividing hooks.

Article No. 738.—The combined tine and chain-harrow which was commended by the Judges is precisely similar in all respects, save that tines are introduced in place of the longitudinal links, and for all purposes in which a cutting or scratching action is desirable this form is preferred. Messrs. Cambridge and Parham state that over 12,000 of these harrows have been sold, and that they consider them preferable for most purposes. Fig. No. 87 shows the arrangement of the tines. The implement is 7 feet 6 inches square. Price, 5*l.*

Fig. 87.—*Messrs. Cambridge and Parham's Combined Tine and Chain Harrow, No.* 738.



a. Dividing hook. *b, b.* Spreaders.

W. Hunt. No. 1641.—Improved flexible self-expanding chain harrow, also commended. No stretcher rods are required, the links being so formed and fitted across the harrow as to keep it rigid at its full width, and at the same time allow sufficient play for it to adapt itself to irregularities of the surface. The harrow is made of wrought-iron links, fitted on one side with sliding spokes or cutters, and can be worked either side up. The links can be replaced by the attendant on the field, and without delay. The width is 7 feet, and the implement costs 4*l.* 10*s.*

Henry Denton. No. 1079.—Chain harrow and carriage. Commended. An ingenious arrangement consisting of a pair of wheels, frame, and shafts; the harrow is carried about wound on the spindle. The workman draws it off the spindle, and a clutch gear connects the spindle with the wheel when it is required to be wound up. It is reasonable in price, costing, with the carriage complete, only 8*l.* 8*s.*, and is light in draught. In work the travelling wheels revolve on the spindle.

Henry Denton. No. 1078.—Chain harrow with tines, entered by mistake in Class 22, for harrows not qualified to compete in other classes, and was, therefore, ineligible. This is like Cambridge and Parham's make in parts; the front length of 3 feet is constructed of $\frac{7}{16}$-in. iron, and has spikes with steel points; the back portion, 4 feet 6 inches long, is composed of ordinary chain-harrow links made of 3 sizes of iron, $\frac{3}{8}$, $\frac{11}{32}$, and $\frac{5}{16}$-in.; the object of this is that the different weights tend to keep the harrow straight, which is further provided for by two $\frac{3}{4}$-inch flexible expanding rods. Fig. 88 shows the form of one of the spokes. Price, 4*l.* 15*s.*

Fig. 88.

Awards.

No. 736.—Prize of 5*l.* to Cambridge and Parham, of St. Philip's Works, Bristol.

No. 1079.—Commended, Henry Denton, of Wolverhampton.

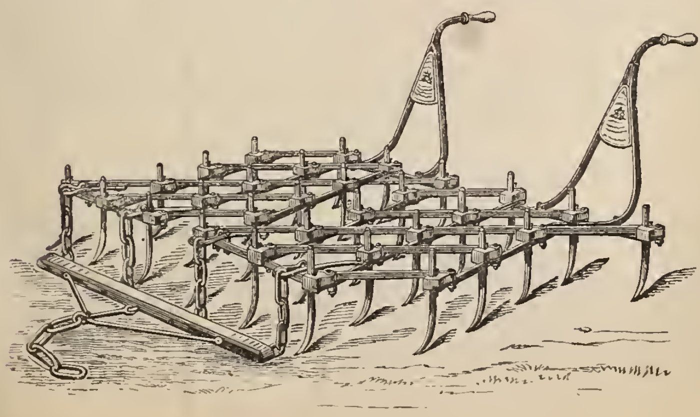
No. 1641.—Commended, William Hunt, of Leicester.

No. 738.—Commended, Cambridge and Parham, of St. Philip's Works, Bristol.

Class 21.—Drag Harrows.

The entries were numerous. The only prize offered, viz. 5*l.*,

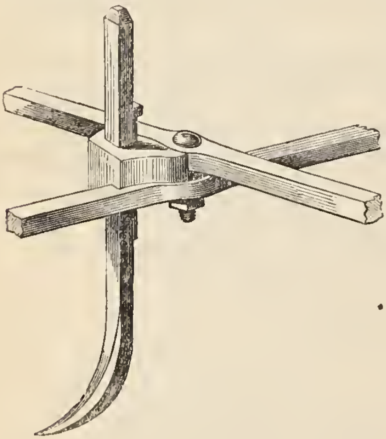
Fig. 89.—*Messrs. E. Page and Co.'s Drag Harrow, No.* 2639.



was awarded to Messrs. E. Page and Co., of Bedford, for article No. 2639, shown in Fig. 89.

The frame consists of two zigzag portions, each with a handle attached to facilitate lifting up in the event of the tines becoming clogged, and each portion carries 15 teeth. The peculiarity consists in the tines being held in malleable castings, which are placed between the cross-bars; the bars are held together by a strong bolt and nut, and the tines are fixed by a key. This arrangement allows of the removal of a portion of the tines, if desirable. The position of the castings, and the form of the teeth, will be understood by the annexed sketch (Fig. 90). These harrows cover 8 feet. The frame is composed of $\frac{3}{4}$ and $\frac{7}{8}$ inch square iron, and the teeth, 13 in number, are 16 inches long. The weight is 3 cwt. 1 lb., and the price 6*l.* 10*s.* The curved tooth, together with the weight, causes these harrows to act in the same manner as a light cultivator, to which they are closely allied.

Fig. 90.—*Tine and Socket of Messrs. E. Page and Co.'s Drag Harrow, No.* 2639.



CLASS 22.—FOR THE BEST HARROW NOT QUALIFIED TO COMPETE IN THE PRECEDING CLASSES.

The prize was awarded to Thomas Hunter, of Maybole, Ayrshire, for Dickson's Patent Expanding Harrows (No. 2986) for harrowing turnip drills. They take two drills at a time, disturb the soil close up to the plants, and are very effective for keeping the soil open, which promotes the circulation of the air within it; but do not answer so well when weeds are numerous, as the latter choke between the tines and cause constant stoppages. Price 4*l.* 10*s.*

SECTION III.—ROLLERS AND CLOD-CRUSHERS.

Here again the entries were numerous. Divided into four classes: Light and Heavy Rollers, Clod-crushers, and Unqualified Rollers and Clod-crushers.

Messrs. Barford and Perkins, well known as the makers of the Water-Ballast Rollers, were very successful, having been awarded First Prizes in the first two Classes.

TABLE IV.—RESULTS OF TRIALS OF HORSE HARROWS AT HULL, 1873.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
							POINTS OF MERIT.							
Class and Description.	Catalogue Number.	Name of Exhibitor.	Size.	Number of Horses.	Weight.	Price.	Weight.	Price.	Mechanism and Strength.	Simplicity.	Economy in Draught.	Quality of Work done.	Total.	Remarks.
							Perfection being							
					cwt. qrs. lbs.	£ s. d.	50.	100.	300.	100.	250.	200.	1000.	
XVII. Light Harrows	2801	W. Ashton	Covers 9 ft. 6 in. in 3 sections. 60 teeth	2	1 2 0	4 4 0	No details of marks given.			..	..	..	750	*First Prize.*
	1640	William Hunt	Covers 10 ft. in 4 sections. 60 teeth	2	2 0 0	5 15 0	..	..	..	..	..	..	700	Teeth screwed into top bar with lock-joint.
	2984	T. Hunter	Covers 10 ft. in 4 sections. 48 teeth ..	2	1 3 0	4 0 0	..	..	..	..	..	..	650	
	3509	G. W. Murray & Co.	Covers 8 ft. 4 in. in 5 sections. 50 teeth ..	2	1 0 0	4 4 0	..	..	..	..	..	..	600	
	2633	E. Page & Co.	Covers 8 ft. in 3 sections. 60 teeth	2	0 3 20	3 5 0	..	..	..	..	..	..	550	
	740	Cambridge & Parham	Covers 7 ft. 4 in. in 3 sections. 60 teeth ..	2	0 3 14	3 7 6	..	..	..	..	..	..	500	
	1281	J. Larkworthy	Covers 7 ft. in 3 sections. 60 teeth	2	0 3 4	3 0 0	..	..	..	..	..	..	450	
	2075	Hill & Smith	Covers 7 ft. 6 in. in 3 sections. 60 teeth ..	2	..	3 12 6	..	..	..	..	..	..	350	
	2400	Maldon Iron Works Company	Covers 7 ft. 6 in. in 4 sections. 60 teeth ..	2	1 3 0	4 5 0	..	..	..	..	..	..	350	
	513	J. Gregory	Covers 8½ ft. in 2 sections. 46 teeth ..	2	1 2 0	3 10 0	..	..	..	..	..	..	300	
	4675	Ashby, Jeffery, & Luke ..	Covers 8 ft. 6 in. in 2 sections. 44 teeth ..	2	..	5 10 0	Not in working order.			..	..	..	..	Rotatory Harrow.
	2800	W. Ashton	.. .. ..	Disqualified.			Considered qualified in Class XIX.							
XVIII. Heavy Harrows	2803	W. Ashton	Covers 10 ft. in 3 sections. 60 teeth	3	2 1 0	6 10 0	50	80	250	60	185	175	800	*First Prize.*
	2911	Ben. Reid & Co.	Covers 9 ft. in 3 sections. 45 teeth	3	4 0 0	5 10 0	40	80	240	60	160	170	750	*Second Prize.*
	1282	J. Larkworthy	Covers 10 ft. 6 in. in 3 sections. 60 teeth	3	2 3 14	6 0 0	20	80	200	80	160	160	700	
	2076	Hill & Smith	Covers 10 ft. 4 in. in 3 sections. 60 teeth .	3	4 2 0	5 5 0	40	80	200	80	125	125	650	
	743	Cambridge & Parham	Covers 9 ft. 6 in. in 3 sections. 60 teeth ..	3	2 0 14	5 5 0	40	80	200	80	100	100	600	
	2985	T. Hunter	Covers 10 ft. in 4 sections. 48 teeth	3	2 2 18	4 15 0	30	60	200	60	75	75	500	
	2182	Maldon Iron Works Company	Covers 8 ft. in 4 sections. 60 teeth	3	..	5 16 0	30	60	200	60	75	75	500	
	2636	E. Page & Co.	Covers 10 ft. 10 in. in 3 sections. 72 teeth	3	3 2 0	5 5 0	30	60	150	65	75	70	450	
XIX. Chisel Harrows	2801	W. Ashton	Covers 6 ft. in 1 section. 29 teeth	4	4 0 0	14 11 0	40	30	250	80	200	200	800	*First Prize.* Depth of teeth, 12 inches, altered with lever.
	4358	Sharman & Ladbury	Covers 6 ft. in 1 section. 25 teeth	4	2 1 0	5 5 0	50	80	180	80	180	180	750	*Second Prize.* Depth of teeth, 9 inches.
	468	Charles Clay	Covers 6 ft. 6 in. in 1 section. 30 teeth ..	4	2 3 0	5 5 0	40	80	160	80	180	160	700	*Highly Commended.*
	2805	W. Ashton	Covers 10 ft. in 3 sections. 60 teeth	4	2 1 0	6 10 0	40	80	150	80	140	160	650	Depth of teeth when at work, 9 inches.
	746	Cambridge & Parham	Covers 5 ft. 3 in. in 2 sections. 30 teeth ..	2	1 2 0	4 0 0	30	50	140	40	120	120	500	Depth of teeth, 6 inches in front, 7 inches behind.
	469	Charles Clay	Covers 7 ft. 9 in. in 1 section. 31 teeth ..	4	4 1 0	9 10 0	30	50	120	40	120	140	500	Depth of teeth, 10 inches.
	1726	Hodgson	Covers 7 ft. in 1 section. 32 teeth	4	2 2 0	4 4 0	30	80	80	60	110	140	500	Depth of teeth when at work, 8½ inches.
	2638	E. Page & Co.	Covers 8 ft. in 2 sections. 30 teeth	4	3 0 1	6 10 0	30	50	140	50	130	100	500	Depth of teeth, 11½ inches.
	511	Gregory	Covers 8 ft. in 2 sections. 42 teeth	2	1 2 0	3 10 0	30	50	70	40	100	110	400	
	3853	J. Robinson	Covers 5 ft. in 2 sections. 40 teeth	4	..	4 4 0	30	50	70	40	100	110	400	
	1256	J. Wilderpin	Covers 4 ft. 6 in. in 1 section. 18 teeth ..	3	2 1 0	5 5 0	30	50	70	40	100	110	400	
	1257	J. Wilderpin	Covers 4 ft. in 1 section. 15 teeth	2	1 2 0	4 5 0	30	50	70	40	100	110	400	Depth of teeth when at work, 10 and 12 inches.
	1281	J. L. Larkworthy	Covers 9 ft. 6 in. in 3 sections. 60 teeth ..	3	1 3 0	5 10 0	..	..	..	..	..	..	..	Broke down during trial.
	2077	Hill & Smith	Covers 9 ft. 6 in. in 3 sections. 60 teeth ..	3	4 2 0	5 15 0	..	..	Did not work.		..	..	..	Depth of teeth, 9 inches.
	1478	William, Ball, & Son	.. .. ..	..	..	..	..	..	Withdrawn.					
XX. Chain Harrows	736	Cambridge & Parham	Covers 8 ft. 6 in. × 7 ft. 6 in.	2	2 0 0	4 15 0	..	..	..	..	..	..	800	*First Prize.*
	738	Cambridge & Parham	Covers 7 ft. 6 in. × 7 ft. 6 in.	2	2 0 0	5 0 0	..	..	..	..	..	..	700	*Commended.*
	1079	H. Denton	Covers 7 ft. × 7 ft. 6 in.	2	2 0 0	8 8 0	Price includes carriage.			..	..	..	650	*Commended* on account of its self-loading.
	1611	William Hunt	Covers 7 ft.	2	2 0 0	4 10 0	..	..	..	..	..	..	650	*Commended.*
	1076	H. Denton	Covers 7 ft. 6 in.	2	2 1 0	4 0 0	..	..	..	..	..	..	500	
	2058	Bayliss, Sons, & Bayliss ..	Disqualified.											
XXI. Drag Harrows.	2639	E. Page & Co.	Covers 8 ft. in 2 sections. 30 teeth	4	3 0 14	6 10 0	50	70	200	100	200	180	800	*First Prize.* Depth of teeth at work, 10½ inches.
	1285	J. Larkworthy	Covers 8 ft. 2 in. in 2 sections. 40 teeth ..	4	2 2 0	6 0 0	30	70	150	100	200	150	700	Depth of teeth at work, 9½ inches.
	2079	Hill & Smith	.. .. ..	4	..	7 0 0	30	70	130	90	150	130	600	
	5102	Perkins & Co.	Covers 9 ft. 9 in. in 2 sections. 50 teeth ..	..	..	..	30	70	140	80	150	130	600	Depth of teeth at work, 10 inches.
	5101	Perkins & Co.	Covers 9 ft. 6 in. in 2 sections. 40 teeth ..	4	..	6 10 0	30	70	140	80	130	150	600	Depth of teeth at work, 10 inches.
	4959	Sharman & Ladbury	Covers 6 ft. 24 teeth	4	2 1 0	6 0 0	30	70	120	60	120	100	500	Depth of teeth at work, 9 inches.
	748	Cambridge & Parham	Covers 6 ft. 6 in. in 2 sections. 30 teeth ..	4	2 0 0	5 5 0	30	70	110	60	100	80	450	Depth of teeth at work, 11 inches in front, 12 inches behind.
	747	Cambridge & Parham	Covers 6 ft. 6 in. in 2 sections. 30 teeth ..	4	..	5 12 6	30	70	110	60	100	80	450	
	1480	William Ball	2 sections. 40 teeth	..	..	5 15 0	30	70	100	60	80	60	400	
	1727	Hodgson	Covers 7 ft. in 1 section. 32 teeth	4	3 0 0	*6 0 0	30	70	100	60	80	60	400	
XXII. Miscellaneous Harrows.	2986	Hunter	Takes 2 drills of potatoes or turnip rows ..	1	1 0 0	4 10 0	..	..	..	..	..	..	600	*First Prize.*
	471	Charles Clay	Covers 4 ft. 6 in. with 11 tines, with sharpened points.	2	5 0 0	9 15 0	..	..	..	..	..	..	400	Twitch gatherer.
	1078	H. Denton	Covers 7 ft. 6 in., spiked chain harrow ..	2	2 2 0	4 15 0	Disqualified.							
	2610	E. Page & Co.	.. .. ..	..	..	3 15 0	Not in order for trial. Tine twisted before trial.							
	1286	J. Larkworthy	Covers 6 ft., with 29 ft.	..	3 0 0	10 10 0	Disqualified. Considered qualified to compete in Class XIX.							

* Entered in Catalogue, £5.

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Table VII.—RESULTS OF TRIALS OF HORSE CULTIVATORS AND SCARIFIERS AT HULL, 1873.

1. Class and Description.	2. Catalogue Number.	3. Name of Exhibitor.	4. Size.	5. Number of Horses.	6. Weight.	7. Price.	8. Number of Field.	9. Width of Land treated in Inches.	10. Depth of Treatment in Inches.	11. Area of Section treated in Square Inches.	12. Weight of Earth disturbed per Yard run in lbs.	13. Foot-lbs. of Work done per lb. of Earth moved. Smallness of Result significant of Efficiency.	14. Draught in lbs.	15. Weight.	16. Price.	17. Mechanism and Strength.	18. Simplicity.	19. Economy in Draught.	20. Quality of Work done.	21. Total.	22. Remarks.
														Perfection Marks: 50.	100.	200.	50.	250.	350.	1000.	
					cwt. qrs. lbs.	£. s. d.															
XXVII. Light Land Cultivators	173	Charles Clay	Covers 4 ft., with 5 tines of 10 in. shares / Covers 3 ft. 6 in., with 5 tines of 2 in. points	..	6 1 4	8 5 0	First Trials in Field 2 after rollers. Final Trials and Dynamometer Trials in Field 1, Tare Stubble.	45	3·1	139·5	291	8·12	788	10	70	110	50	203	300	800	*First Prize.*
	3030	Coleman & Morton	Covers 4 ft. 10 in., with 7 tines of 10 in. shares / Covers 4 ft. 6 in., with 7 tines of 6 in. shares	4	5 3 15	12 0 0		58	2·67	151·8	324	10·82	1169	10	70	110	50	200	250	750	*Second Prize.*
	481	Charles Clay	Covers 5 ft., with 7 tines and 10 in. shares / Covers 4 ft. 6 in., with 7 tines of 2 in. points	4	6 6 6	13 5 0		..	..	..	..	..	..	10	60	130	50	100	200	600	
	2855	Corbett & Peele	Covers 5 ft. 2 in., with 9 tines with 10 in. shares / Covers 5 ft. 2 in., with 9 tines with 2½ in. points	4	5 1 20	10 15 0		..	..	..	..	..	..	40	70	120	50	120	200	600	
	3510	G. Murray & Company	Covers 3 ft. 5 in., with 5 tines of 5¾ in.	2	1 1 7	11 0 0		..	..	..	..	..	..	10	70	140	50	100	230	600	
	380	E. H. Bentall	Covers 4 ft. 6 in.	4	1 2 0	8 8 0		..	..	..	..	..	..	30	30	120	30	30	250	550	5 shares of 12 inches, with fine at wing of shares.
	1186	E. Ball & Son	Covers 5 ft., with 9 tines of 8 in. shares	4	..	9 10 0		..	..	..	..	..	..	10	80	100	10	100	140	500	
	2837	Carson & Toone	Covers 4 ft., with 5 tines of 12 in. steel shares	4	6 0 0	10 10 0		..	..	..	..	..	..	10	80	80	30	70	100	400	
	2915	Ben. Reid & Company	Covers 3 ft., with 5 tines of 6 in. points	4	4 2 5	8 0 0		..	..	..	..	..	..	40	80	80	30	70	100	400	
	2081	Hill & Smith	Covers 3 ft. 6 in., with 5 tines of 4 in. points	4	..	10 0 0		..	..	..	..	..	..	Implement broke down in Trial.							
	1636	William Hunt	Covers 4 ft. 8 in., with 7 tines of 9 in. shares / Covers 4 ft. 2 in., with 7 tines of 2 in. points	4	4 2 0	8 10 0		57	2·6	148·2	310	8·95	925	Implement broke down in Trial.							
XXVIII. Heavy Land Cultivators.	178	Charles Clay	Covers 3 ft. 6 in.	4	6 1 0	10 5 0	First Trials in Field 2. Final Trials on Tare Stubble, Field 1.	48	4·7	225·6	471	8·97	1108	40	70	135	50	180	325	800	*First Prize.*
	1637	William Hunt	Covers 4 ft. 2 in., or 4 ft. 6 in., or 4 ft. 9 in.	4	6 2 4	11 10 0		56½	5·0	282·5	590	9·08	1785	20	80	100	20	180	359	750	*Second Prize.*
	3095	Coleman & Morton	Covers 4 ft. 8 in., or 4 ft. 10 in., steel and iron tines	4	8 0 1	16 0 0		58	4·95	287·1	600	Chilled Tines 10·81 / Steel Tines 7·55	2169 / 1519	40	80	120	20	165	300	725	*Highly Commended.*
	3541	G. W. Murray	Covers 3 ft. 4 in., 5 tines, 5¾ in. shares	4	4 0 0	12 12 0		41	5·4	221·	462	11·07	1705	35	60	140	30	175	210	650	Principally adapted for heavy land and very deep work, depth of work 6 inches and 3 inches.
	2810	William Ashton	Covers 5 ft. 3 in.	4	5 3 0	13 13 0		..	..	..	..	..	..	30	60	125	30	180	175	600	Depth of work 6 inches and 3 inches.
	1323	Mellard's Trent Foundry	Covers 4 ft. 7 in.	4	6 2 25	9 10 6		..	..	..	..	..	..	35	60	140	30	175	160	600	Depth of work 6 inches and 3 inches.
	1181	William Ball & Son	Covers 5 ft. 6 in.	4	4 0 0	10 0 0		..	..	..	..	..	..	20	50	100	30	130	170	500	Depth of work 6 inches and 3 inches.
	2856	Corbett & Peele	Covers 5 ft. 3 in.	4	7 3 12	12 15 0		..	..	..	..	..	..	30	50	80	20	130	190	500	Depth of work 6 inches and 3 inches.
	400	E. H. Bentall	Covers 6 ft. 2 in.	4	6 2 0	9 9 0		..	..	..	..	..	..	20	60	100	20	..	200	400	Depth of work 6 inches and 3 inches.
XXIX. Broadshares	479	Charles Clay	Covers 4 ft., with 5 tines of 10 in. shares / Shares malleable iron	2	6 0 26	11 0 0	Trials in Fields 2 and 1.	..	..	..	..	..	..	Marks not given in detail.						800	*First Prize.*
	3026	Coleman & Morton	Covers 4 ft. 10 in., with 7 tines of 10 in. shares	2	9 0 0	16 0 0		..	..	..	..	..	..	..	..	..	..	..	..	780	*Highly Commended.*
	390	E. H. Bentall	Covers 4 ft. 6 in., with 5 tines of 6 in. wings	4 or 2	1 2 0	8 8 0		..	..	..	..	..	..	..	..	..	..	..	..	700	4 horses required when working 3 inches deep, 2 when working 1½ inches deep.
	2812	Ashton	Covers 5 ft., with 7 tines of 11 in. shares	..	5 1 0	13 13 0		..	..	..	..	..	..	..	..	..	..	..	..	600	
	1183	William Ball & Son	Covers 4 ft. 4 in., with 7 tines of 9 in. shares	2	..	8 15 0		..	..	..	..	..	..	..	..	..	..	..	..	500	
XXX. Cultivator or Scarifier, not qualified for other classes.	180	Charles Clay	Covers 4 ft. 6 in., with 7 tines, 2 in. points / Covers 5 ft., with 7 tines, 10 in. points	4 or 2	..	12 0 0		..	..	..	..	..	..	..	..	..	..	..	..	800	*First Prize.* Requires 4 horses when working 5 inches deep, 2 horses when working 2½ inches deep.
	1181	William Ball & Son	Covers 4 ft. 6 in., with 2 in. points / Covers 6 ft. 2 in., with 9 in. shares	4 or 2	1 2 0	9 10 0		..	..	..	..	..	..	..	..	..	..	..	..	500	*Second Prize.* Requires 4 horses when working 5 inches deep with 2 points, 2 horses working 2½ inches deep with shares.
	516	J. Gregory	Covers 3 ft. 3 in., with 2 in. points / Covers 4 ft., with 10½ in. shares	4 or 2	5 0 1	..		..	..	..	..	..	..	..	..	..	..	..	..	400	Requires 4 horses when working 5 inches deep, 2 horses when working 2½ inches deep.

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Class 23.—For the best Light Roller.

The first prize was awarded to article No. 140, a Water-Ballast Roller, composed of two cylinders, 18 inches diameter, and covering together 6½ feet. The cylinders are constructed of the best boiler-plate iron, the ends being securely fastened by rivets. The framework is of cast iron, and the wooden shafts are secured by 4 strong bolts and nuts. The ability to make the same implement into either a light or heavy roller by the addition or withdrawal of the water with which it is ballasted is an important consideration, as we get the effect of two implements in one. The process of filling is readily effected by removing a brass plug in the surface of the cylinder. A key fitting the same is supplied with each roller, and the plug is so countersunk that the threads of the screw are not liable to be injured by pressure. A funnel is also supplied fitting into the hole, and thus the filling is easily accomplished. The weight can be increased from 8 to 14 cwt. Price, 17*l.* 10*s.*

Article No. 144, also shown by *Messrs. Barford and Perkins*, was highly commended. This is similar in form, only the cylinders are of larger diameter and open. The superiority of wrought over cast iron for the cylinders is a point of importance, as the latter is liable to fracture in consequence of any violent jar. The advantages of a double cylinder are found principally in greater facility of turning. The frame is precisely similar to that of No. 140. The price is 13*l.* 10*s.* This roller has a seat for the driver, a desirable addition.

The Beverley Iron and Waggon Company were awarded the second prize in Class 23 for article No. 1383, a Plain Field Roller, composed of four wrought-iron cylinders, each 2 feet long and 21 inches diameter. Here, as in the clod-crushers, the castings which carry the frame and shafts are so arranged as to take the weight off the horse's back. The roller costs 12*l.* 10*s.*, and 1*l.* extra if supplied with a driver's seat.

Mr. W. Hunt, of Leicester, was commended for article No. 1638. This roller is made with three wrought-iron cylinders. The centre of the shaft is square, and thus drives the two outside cylinders, an arrangement which tends to reduce friction. The roller is self-lubricating, and fitted with renewable bushes and grease-boxes. The cylinders are 24 inches diameter, and cover 7 feet of ground. Price, 14*l.* 10*s.*

Class 24.—For the best Heavy Roller.

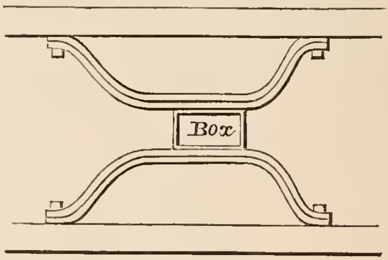
Here again, as in Class 23, the entries were large.

The Water-Ballast Roller, combining great weight in a reasonable compass, was evidently most desirable as a heavy roller. *Messrs. Barford and Perkins* showed no less than six—three on this principle, and three made of cast metal, the cylinders being in three parts: the latter are cheaper, but far less effective. The roller selected for the first prize was No. 147, precisely similar to the implement No. 140 (which was in a similar position in Class 23), only much larger, viz. 24 inches diameter. Weight, empty, 11 cwt.; full, 22 cwt. Price, 21*l.*

The Second Prize was awarded to the *Beverley Iron and Waggon Company* for Roller No. 1386, which consists of nine cast-iron rings, 2 feet 8 inches diameter and 8 inches wide, thus covering 6 feet of ground. These cylinders are placed upon a round axle. The arms have grease-boxes and loose bushes. This is a very well-made implement. The draught-irons are arranged for the side-horses to draw directly from the axle, and thus, their work being independent of the shaft-horse, there is no possibility of his having to bear unnecessary pressure. Price, 19*l.*

Messrs. W. Crosskill and Sons were highly commended for article No. 438, a 30-inch open Roller, covering 6 feet, and costing 18*l.* The cylinder is made in seven sections. The outside section has bevelled edges to prevent the land being disturbed when turning. The wooden frame is braced with angle-iron,

Fig. 91.—*Braces of Messrs. Crosskill's Roller, with Box for Tools.**



with a box in the centre forming a receptacle for tools (Fig. 91). The standard is arranged so as to keep the weight from off the horse's back.

Clod-crushers.

The Judges expressed a decided opinion in favour of serrated over fluted discs. The former broke the clod, whilst the latter frequently pressed it unbroken into the loose soil.

The machines made by the Beverley Iron and Waggon Company and by Messrs. Crosskill and Sons, of Beverley, differ only in detail. The former have, however, some points of construction that entitle them to the first place.

Article No. 1388, which received the First Prize, consists of a series of alternate discs hung loosely on the axle, 30 and 33 inches diameter; the central holes in the larger discs are correspondingly increased, so that the discs are level on the ground. The flanges of the larger discs completely cover the bushes of the smaller ones. The advantage of this arrangement is manifest; dirt cannot get into the shaft, and the discs are not subject to the same amount of side-wear at the bosses as was the case formerly. The outer surface of each disc is serrated, the pitch of the teeth being sharp; it also has a series of teeth projecting sideways, which act perpendicularly in breaking clods, and in the case of the smaller discs also act as cleaners. The cast-iron supports for the frame are so made that the back one being thrown more from the centre, acts as a counterpoise to the weight of the frame and shafts, and tends to relieve the weight on the shaft-horse's back, which is further secured by the position of the driver's seat. The side horses draw direct from the axles. The bushes of the travelling-wheels are necessary to fill up the space between the arms and the linch-pins when the implement is in work; they cannot be thrown about and lost, as was the case not unfrequently when their only use was when the wheels were on for travelling. The illustrations (Figs. 92 and 93) will show the arrangement of the alternate discs, the loose position of the larger discs on the axle, the bush of the travelling-wheels, the driver's seat, and the arrangement of bracket to secure counterpoise.

* The box is erroneously shown on one side instead of in the centre.—Ed.

TABLE V.—RESULTS OF TRIALS OF HORSE ROLLERS AT HULL, 1873.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
							POINTS OF MERIT.							
Class and Description.	Catalogue Number.	Name of Exhibitor.	Size.	Number of Horses.	Weight.	Price.	Weight.	Price.	Mechanism and Strength.	Simplicity.	Quality of Work done.	Variations of Weight.	Total.	Remarks.
							Perfection being							
							100.	100.	150.	150.	350.	150.	1000.	
					cwt. qrs. lb.	£. s. d.								
XXIII. Light Rollers.	140	Barford & Perkins	6 ft. 6 in. in 2 sections. Water ballast, 18 in. diameter, 8 cwt. empty, 14 cwt. full.	1	8 0 0	17 10 0	70	60	120	120	330	150	850	*First Prize.*
	1383	Beverley Iron Company ..	Covers 8 ft. in 4 sections, 21 in. diameter	1	9 2 0	12 10 0	80	80	120	130	310	..	720	*Second Prize.*
	144	Barford & Perkins	21 in. diameter by 6 ft. 6 in. wide, in 2 sections	1	..	13 10 0	80	70	120	130	300	..	700	*Highly Commended.*
	1638	William Hunt	21 in. diameter by 7 ft. wide, in 3 sections ..	1	10 2 0	14 10 0	80	60	100	120	290	..	650	*Commended.*
	4330	Holmes & Son	16 in. diameter by 7 ft. 6 in. wide, in 3 sections	..	..	8 10 0	80	60	100	120	240	..	600	
	2852	Corbett & Peele	16 in. diameter by 6 ft. 6 in. wide, in 13 sections	1	12 0 0	12 5 0	80	60	100	120	240	..	600	
	727	Cambridge & Parham	15 in. diameter by 7 ft. wide, in fluted sections	1	8 0 0	12 0 0	60	60	100	100	230	..	550	
	143	Barford & Perkins	18 in. diameter by 6 ft. 6 in. wide, in 2 sections	1	..	10 10 0	40	70	100	100	190	..	500	
	1384	Beverley Iron Company ..	20 in. diameter by 7 ft. 6 in. wide, in 12 sections	2	13 0 0	13 10 0	20	70	120	100	190	..	500	Considered too heavy as a light roller.
	2641	E. Page & Company	7 ft. wide, in 3 sections	1	6 0 0	8 15 0	40	70	100	100	190	..	500	
	1385	Beverley Iron Company ..	21 in. diameter by 6 ft. wide, in 2 sections ..	1	13 0 0	12 10 0	50	50	100	60	140	..	400	
	2081	Hill & Smith	24 in. diameter by 7 ft. wide	1	..	14 14 0	40	30	60	100	140	..	370	
	142	Barford & Perkins	15 ft. diameter by 6 ft. 6 in. wide in 2 sections	1	..	9 10 0	..	50	100	100	50	..	300	
XXIV. Heavy Rollers.	117	Barford & Perkins	24 in. diameter by 6 ft. 6 in. wide, in 2 sections	2	11 0 0	21 0 0	70	60	120	120	330	150	850	*First Prize.* Water-ballast roller, when full, weighs 22 cwt.
	1386	Beverley Iron Company ..	32 in. diameter by 6 ft. wide, in 9 sections ..	3	22 0 0	19 0 0	100	80	145	120	280	..	725	*Second Prize.*
	138	William Crosskill & Sons ..	30 in. diameter by 6 ft. wide, in 7 sections ..	1	20 0 0	18 0 0	100	80	120	120	280	..	700	*Highly Commended.*
	119	Barford & Perkins	30 in. diameter by 6 ft. 6 in. wide, in 2 sections	4	14 0 0	33 0 0	40	40	100	100	210	150	650	Water ballast roller, when full, weighs 30 cwt.
	2853	Corbett & Peele	26 in. diameter by 6 ft. 6 in. wide, in 13 sections	3	22 0 0	17 5 0	70	90	100	120	220	..	600	
	1639	William Hunt	30 in. diameter by 7 ft. wide, in 3 sections ..	3	18 2 0	18 10 0	80	80	100	120	220	..	600	Wrought-iron roller, in 3 parts.
	118	Barford & Perkins	27 in. diameter by 6 ft. 6 in. wide, in 2 sections	2	12 0 0	28 10 0	40	40	100	100	150	150	580	Water-ballast roller, when full, weighs 26 cwt.
	151	Barford & Perkins	30 in. diameter by 6 ft. 6 in. wide, in 3 sections	4	24 0 0	23 0 0	60	45	100	120	150	..	475	
	2082	Hill & Smith	36 in. diameter by 6 ft. 6 in. wide, in 2 sections	2	21 0 0	21 0 0	40	25	20	70	145	..	300	

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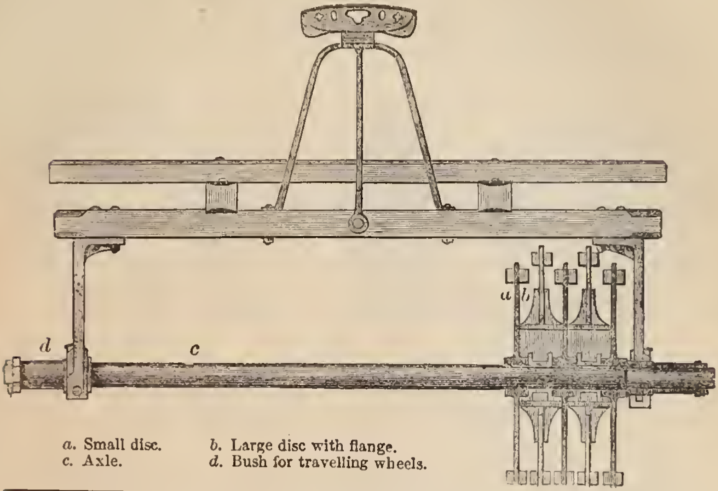
TABLE VI.—RESULTS OF TRIALS OF CLOD-CRUSHERS AT HULL, 1873.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
							POINTS OF MERIT.							
CLASS AND DESCRIPTION.	Catalogue Number.	Name of Exhibitor.	SIZE.	Number of Horses.	Weight.	Price.	Weight.	Price.	Mechanism and Strength.	Simplicity.	Economy in Draught.	Quality of Work done.	Total.	REMARKS.
							PERFECTION BEING							
					cwts. qrs. lbs.	£. s. d.	50.	100.	150.	50.	50.	500.	1000.	
XXV. Clod-crushers.	1388	Beverley Iron Company ..	Rollers 30 in. and 33 in. diameter, covers 6 ft.	4	22 2 0	25 0 0	50	70	120	40	120	400	800	*First Prize.*
	436	William Crosskill & Sons ..	Rollers 30 in. diameter, covers 6 ft.	4	24 0 0	24 0 0	40	80	120	40	110	350	740	*Second Prize.*
	1389	Beverley Iron Company ..	Rollers 21 in. and 27 in. diameter, covers 6 ft.	2	15 2 0	20 10 0	40	60	120	40	120	250	630	
	437	William Crosskill & Sons ..	Rollers 20 in. diameter, covers 5 ft. 6 in.	2	20 0 0	24 0 0	40	60	120	40	120	250	630	
	157	Barford & Perkins	Rollers 26 in. diameter, covers 6 ft. 6 in.	3	20 2 0	20 10 0	40	80	120	50	150	160	600	*Highly Commended.*
	153	Barford & Perkins	Rollers 26 in. diameter, covers 6 ft. 6 in.	3	19 1 0	18 10 0	40	85	100	40	110	125	500	Good implement, better adapted for rolling corn.
	2851	Corbett & Peele	Rollers 26 in. diameter, covers 6 ft. 6 in.	3	23 0 0	16 10 0	40	100	120	40	100	100	500	
	151	Barford & Perkins	Rollers 30 in. diameter, covers 6 ft. 6 in.	4	22 0 0	23 0 0	30	70	100	30	100	120	450	Good implement, better adapted for rolling corn.
	1387	Beverley Iron Company ..	Rollers 26 in. diameter..	3	20 2 0	19 10 0	30	70	100	30	100	120	450	
	155	Barford & Perkins	Rollers 30 in. diameter, covers 6 ft. 6 in.	4	30 0 0	26 0 0	20	60	100	..	100	120	400	
	733	Cambridge & Parham	Rollers 30 in. diameter, covers 7 ft.	4	cwt. 25 or 26	24 0 0	20	50	80	..	80	100	330	
	732	Cambridge & Parham	Rollers 26 in. diameter, covers 7 ft.	2	..	20 0 0	20	50	80	..	80	80	310	
	2083	Hill & Smith	Rollers 20 in. diameter, covers 6 ft.	2	11 0 0	11 0 0	Not tried.							
XXVI. Miscellaneous Rollers or Clod-crushers.	1865	Brigham & Company	Rolls 2 potato rows at once; serrated edges ..	2	..	..	40	20	100	50	60	430	700	*First Prize.*
	1866	Brigham & Company	Rolls 2 potato rows at once; fluted edges ..	2	..	7 15 0	40	20	100	50	60	330	600	
	472	Charles Clay	Covers 5 ft.	..	8 1 0	12 0 0	30	40	80	30	80	110	400	Spike or Norwegian Harrow.
	1904	J. B. and J. Sainty	Covers 6 ft. 6 in., in 3 sections	2	..	12 10 0	Not practical implement.							Flat roller in 3 parts, with jointed spindle.

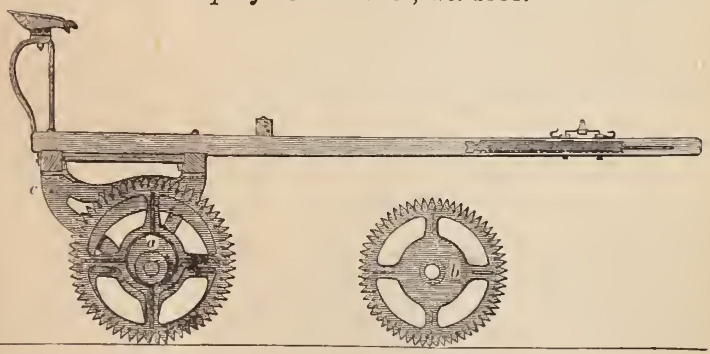
EASTONS AND ANDERSON, Consulting Engineers R.A.S.E.

Fig. 92.—*Transverse Section of the Beverley Iron and Waggon Company's Clod-crusher, No.* 1388.



a. Small disc. *b.* Large disc with flange.
c. Axle. *d.* Bush for travelling wheels.

Fig. 93.—*Longitudinal Section of the Beverley Iron and Waggon Company's Clod-crusher, No.* 1388.

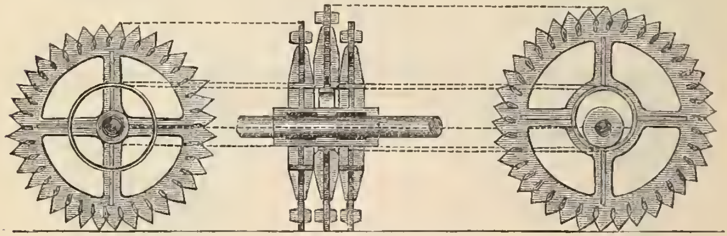


a. Opening of large discs allowing play. *b.* Opening of small disc; same dimensions as axle.
c. Arrangement of bracket to secure counterpoise.

Messrs. W. Crosskill and Sons received the Second Prize for article No. 436. The discs are also of two sizes; the larger ones 30 inches, the smaller ones 3 inches less. The difference in the construction is that the smaller discs have the larger bosses and the larger discs work loose on them; thus they have a great deal of play and act as cleaners. The axle works in a removable bush, which saves the frame from wearing. The bracket-arms are similarly balanced, as those in the clod-crusher last described, but there is no driver's seat, and the side-horses draw from the frame instead of direct from the axle. The work done was equally good, but in point of detail the arrangements of the Company's implement were the more meritorious.

The differences of construction are well shown in the accompanying section of the discs, with a side elevation of the two.

Fig. 94.—*Side Elevation and Section of the Discs of the Clod-crushers exhibited by the Beverley Iron and Waggon Company, No.* 1388, *and by Messrs. Crosskill and Sons, No.* 436.



Croskill. Beverley Co.

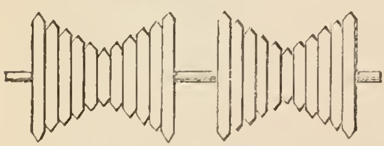
Messss. Barford and Perkins were highly commended for their Improved Press-Wheel Cambridge Clod-crusher. This is a powerful roller, 26 inches diameter, and covering 6½ feet. It is similar to Cambridge's original pattern, having fluted discs, and it makes excellent work when the lumps are tractable; but, when the land is really hard and strong, such implements rather press the obstructions into the soil than break them. Hence the prizes were given to clod-crushers with serrated teeth. The frame in this case deserves notice, as it is made of solid wrought iron, and is fitted with a steerage rod, driver's seat, and Stanley's patent self-acting scrapers. The price complete was 20*l.* 10*s.*

Class 26.—For the best Roller or Clod-crusher not qualified to compete in the preceding Classes.

Although the names of four Exhibitors appeared in the list, only two came to trial, viz. Messrs. Brigham and Company with articles Nos. 1865 and 1866, and J. B. and J. Sainty with No. 1994; and as both are novelties, we may briefly describe their peculiarities.

Messrs. Brigham and Co.'s Roller (No. 1865) is a Drill Roller; that is, a roller specially designed to reduce clods in drills. It consists of two parts, each consisting of eleven sections, these sections being partly serrated and partly fluted; the external discs are fluted, and the sections are much smaller towards the centre to suit the form of the drill. Fig. 95 will convey some idea of the form of the discs, but it represents the second form shown, as the serrated edges, which distinguish the prize implement, are not visible. A careful trial of the two proved the greater efficacy of the serrated discs, which might have been expected, as it confirmed the experience in the class of clod-crushers. The inventors state that these rollers have proved most effective upon bean, potato, and turnip drills. The same result is, however, obtained by the use of concave harrows, and

Fig. 95.—*Messrs. Brigham and Co.'s Drill Roller, No.* 1865.



it is a question for practical experience to decide which is most valuable. The price is rather heavy, being 7*l.* 15*s.*

Messrs. Sainty's invention (No. 1994) is a Heavy Roller, in three parts or sections, which are relatively in the same position as the wheels and steerage of Aveling and Porter's Steam Roller. The two back rollers are hung upon a double-jointed axle, so that each section is free to adapt itself to irregularities of the surface. The double joint is in the centre, the ends of the spindle are attached to a cross-bar of iron, and hung on the frame. The arrangement of the rollers is highly ingenious, and the action of the jointed axle is perfect in allowing each roller to reach the holes; but the construction was seriously defective, and the front section far too small to allow of turning without disturbing the soil. Self-acting scrapers, consisting of a series of hoes set diagonally on a bar, hinged at one end and free at the other, operate by their weight.

Fig. 96.—*Messrs. Sainty's Heavy Roller, No.* 1994.

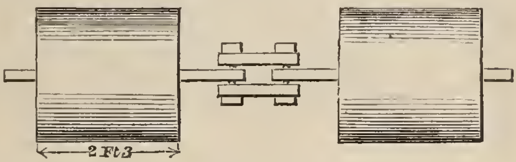


Fig. 96 shows the two hind sections and the jointed spindle. The horses draw from the axle of the front section, not shown in the illustration. The motion was unsteady, and the rollers, instead of working true, were actuated by a series of jerks. These are details capable of improvement. The cylinders are constructed so as to hold water if required. We can understand that such a roller might prove of great use when the surface was unequal. Suppose, for example, a furrow with gradually rising land on each side, keeping the horse in the furrow, the hind rollers would adapt themselves to the nature of the surface. The price, which, however, is no criterion as to value, the machine being very badly made, is stated to be 9*l.* 10*s.*, with 1*l.* extra for the scrapers.

The Prize of 10*l.* was awarded to Brigham and Co., of Berwick-on-Tweed, for article No. 1865.

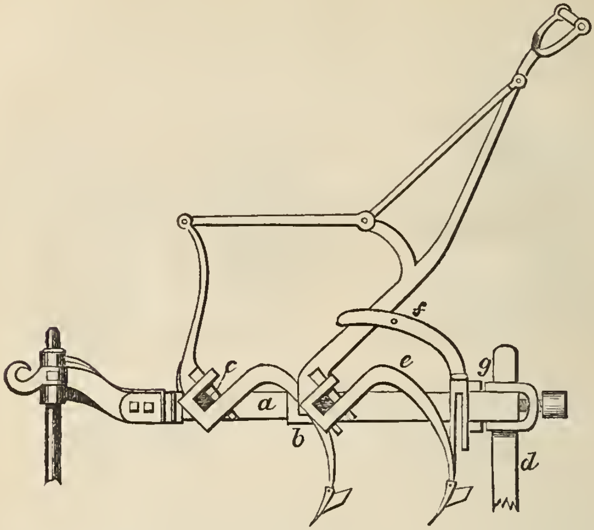
Section IV.—Cultivators and Scarifiers.

The Cultivators and Broadshares shown by C. Clay, of Wakefield, which were successful, taking first prizes in Classes 27, 28, 29, and 30, are identical in construction, and only differ according to requirements in width, strength of material, and the number of tines, one description will therefore suffice.

The frame is supported by three wheels, two behind and one in front; these wheels are independent of each other, the arms being attached to the frame by a strong loop and screw bolt. Their principal use is to regulate the depth of work; in the larger machines the alteration is facilitated by means of lever handles as shown in Fig. 99. Within the frame strong bars work in carriages, being moved partly round by the action of the lever and arm.

On these bars the tines are fixed by means of a wedge or cotter, and can be removed, or their position altered, to suit the nature of the work, more or fewer

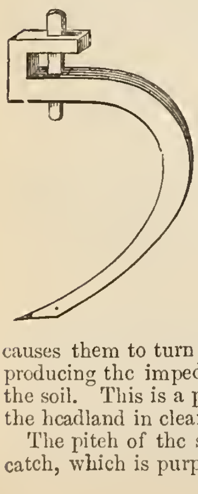
Fig. 97.—*C. Clay's Cultivator and Broadshare, No.* 479.



a. One side of frame.
b. Portion of carriage
c. Section of angular bar actuated by lever and arm.
d. Wheel arm showing attachment to frame.
e. Tine.
f. Guide holding catch shown at *g.*

tines can thus be used, according as the land is clean or foul, or whether a fine or rugged condition is required. This will be readily understood by reference to the accompanying drawing of a tine (Fig. 98) in the position for work; the bent form of the tine is undoubtedly advantageous, inasmuch as weeds that come in contact under the surface pass upwards and backwards; there is less resistance from the soil, and, when the lever is up and the tines out of work, they are placed close under the frame and clear of everything (see Fig. 97).

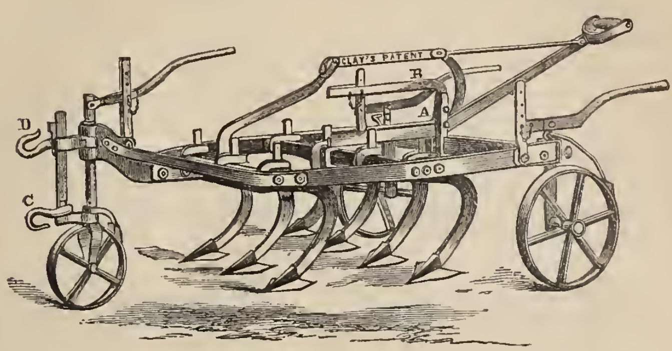
Fig. 98.



The action of the lever will be best understood by a glance at Figs. 97 and 99. The latter shows one of the larger cultivators in work, fitted with the levers to wheels and fallow hook C. It will be seen that when in work the lever is in the catch or notch at A, Figs. 99 and 100. Should it be desirable to raise the tines, either because of rubbish or at the land's-end, the lever is released by means of the handle, and either raised to B or allowed to take the position shown in Fig. 97. The form of the tines causes them to turn backwards to such a degree that the stubble, weeds, &c., producing the impediment, fall out, and the tines can be let down again into the soil. This is a point of considerable importance, no time being wasted at the headland in cleaning the tines.

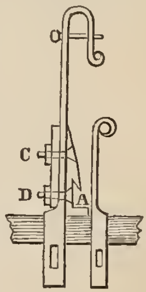
The pitch of the shares can be regulated by altering the position of the catch, which is purposely made movable; all that is necessary is to unloose the nuts shown at C and D, Fig. 100, which hold the catch in its place on the guide, and raise it a little higher and fix the nuts. It will be seen from

Fig. 99.—*C. Clay's Cultivator and Broadshare, No.* 479.



the illustrations that the leverage is required to keep the tines in the ground, and it is a question whether this is so good a plan as the opposite, where the position of the tines ensures their entering into work, and the leverage is exerted in order to raise the tines at the land's-end; in the one case we have the strain of the leverage during work, which should be very much the longer period, in the other only when out of the ground. Still the ability to relieve itself when choked is a great and counterbalancing advantage; moreover, the form of the tines facilitates the action of the lever, for when the movement of the bar brings the weight over the centre of gravity the weight of the tines themselves completes the required movement, and all that is necessary on the part of the attendant is to steady the descent of the handle and place the same in the catch.

Fig. 100.
Patent movable Catch.



In Fig. 99 two coupling hooks are shown. The object of the lower one, marked C, is for fallow land; by attaching the horses to it instead of the upper one, which is the proper attachment under ordinary circumstances, the forward part of the frame is lifted, and the tendency to sink prevented. Various shares can be used, from narrow cultivating points to square and V-shaped shares 12 inches wide. It will be seen by reference to the tables that Mr. Clay's position at the head of four classes was partly due to the favourable results of the dynamometric experiments. The character of the work being equal, that implement which takes the least power must be the best, provided it is sufficiently strong to resist the maximum strain to which it can be liable in fair work. No doubt the Judges were satisfied on this point by the examination of the strength of material and workmanship: had they been in doubt, the report of the Judges at Leicester might have been usefully consulted. We venture to quote their words: "These implements were tried on a piece of tare stubble, from which the crop had been recently removed, and which was in a tolerably friable state on the surface, but exceedingly hard and tough below: so much so that only two out of the eighteen selected for trial were able to withstand the severity of the strain." Those two were Bentall's and Clay's, which were placed accordingly.

In Class 30, the Prize was offered for the best implement for cultivating or scarifying purposes, not qualified to compete in the preceding Classes. Here Mr. Clay entered an implement precisely similar as to mechanism with those which had competed before, but fitted with drag teeth. Thus showing the adaptability of the implement for a variety of different operations, each of which is equally well performed. A farmer buying one of these Cultivators, with all necessary appliances, has a cultivator, broadshare, and drag-harrow combined, all easily worked and thoroughly efficient. We object to a combination, when quality of work is sacrificed to obtain it; but it is highly meritorious when the same implement is perfect in three distinct operations.

Messrs. Coleman and Morton, of Chelmsford, have been long known in connection with an excellent cultivator. The lifting apparatus consists of a strong central beam, held in brackets on either side of the frame, and actuated by a lever handle. The tines, or prongs, five in number, are connected with the beam by rods $1\frac{1}{8}$ inch by $\frac{3}{8}$ inch attached to their upper end; each tine is suspended to the frame by a screw-bolt working in a slot, which allows the requisite freedom of action. The depth of the tines in reference to the frame can be altered according to the hole through which the screw-bolt passes, altering at the same time the point of connection between the top of the tine and the connecting rods. The tines are made both of cast and wrought metal. Shares of great variety are supplied, so as to effect a variety of operations.

Fig. 101.—*Elevation of Messrs. Coleman and Morton's Cultivator, No.* 3093.

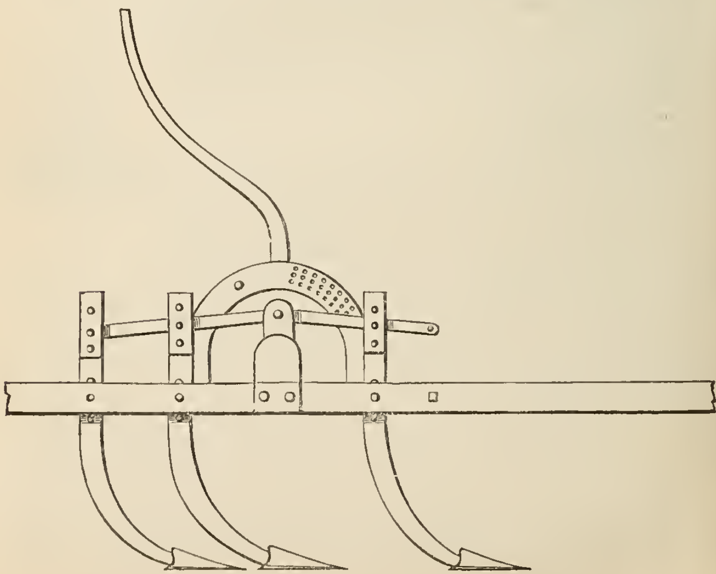
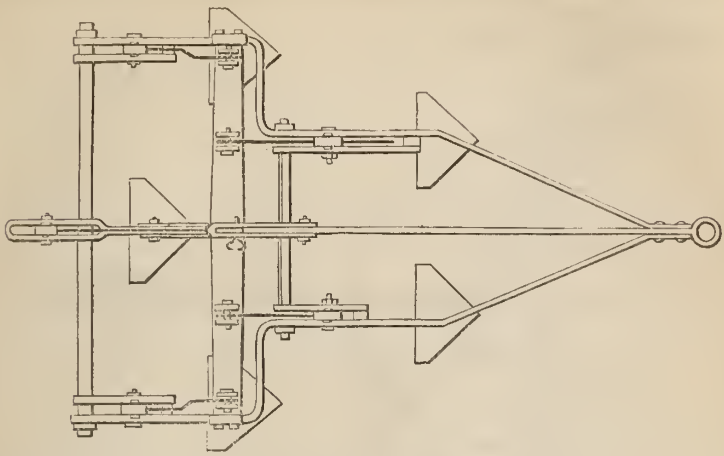


Fig. 102.—*Plan of Messrs. Coleman and Morton's Cultivator, No.* 3093.

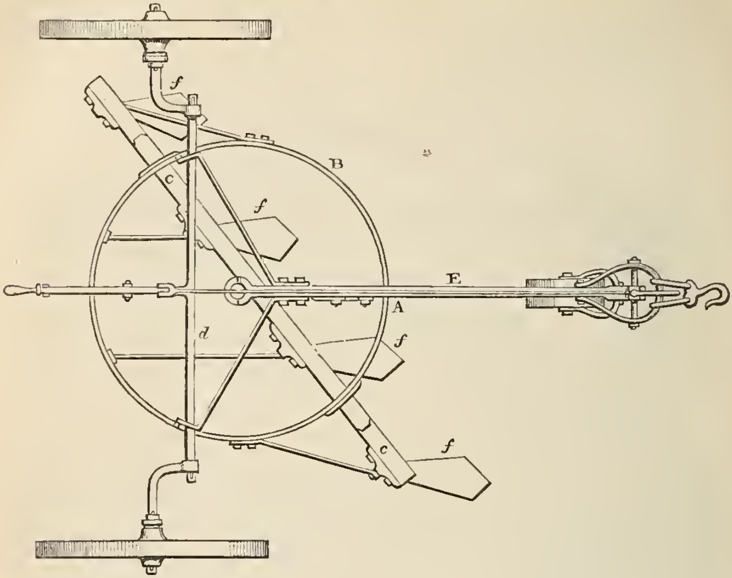


The depth is regulated by altering the stop in front of the lever handle, and so keeping the tines in a more upright or forward position. When required to clear the ground at the land's-end, or when travelling, the lever handle is pulled down sufficiently to allow the stop being inserted in the hole shown in the elevation (Fig. 101).

There is great simplicity and strength combined in these machines, nothing more than the bending of a tine from contact with a root or fast stone need be apprehended. It will be seen by reference to the tables that the draught was greater than with Clay's cultivator, and it was this which in great measure decided the relative position of these machines.

Murray and Co. showed a complete novelty in their cultivator (No. 3510) for light land, which, though not in the prize list, was thought deserving of a careful trial, and made good work. We trust to be able to make our readers understand the peculiar construction of this implement by means of two illustrations showing a side elevation and plan (Figs. 103 and 104). The centre frame is formed of a round ring of flat iron on its edge, having an angle-iron bar 2½ inches square extending right across the same, framed and braced together, to which the tines or radial breast arms are attached; this, which may be distinguished as the lower frame, is held together quite independently of the upper frame, consisting of the beam, crank axle, wheels, lever, handle, and stop, all which parts are framed together, but separate from the lower frame; the two are attached together by a large stud or boss in the centre, upon which the under frame turns when required, like the fore-carriage of a four-wheeled machine, the object of this freedom being that the radial arms can be made to follow each other in a narrow track, viz., only covering 3 feet 2 inches, or the frame can be set to take nearly 5 feet, according to the angle in reference to the line of draught; this is a highly ingenious arrangement. The two frames are made rigid in work by a bolt, shown at A in Fig. 103, which goes through the beam and the rings of the lower frame. The depth is regulated by a movable stop shown at B in Fig. 104. The form of tines and breasts used, both for this implement and for a heavy-land cultivator, are peculiar. They are formed of steel plates like the mouldboard of a plough, and terminate in a diamond point. Fig. 105 shows a plan of the share. The plates are also twisted like a plough-board, but the angle is more acute. The

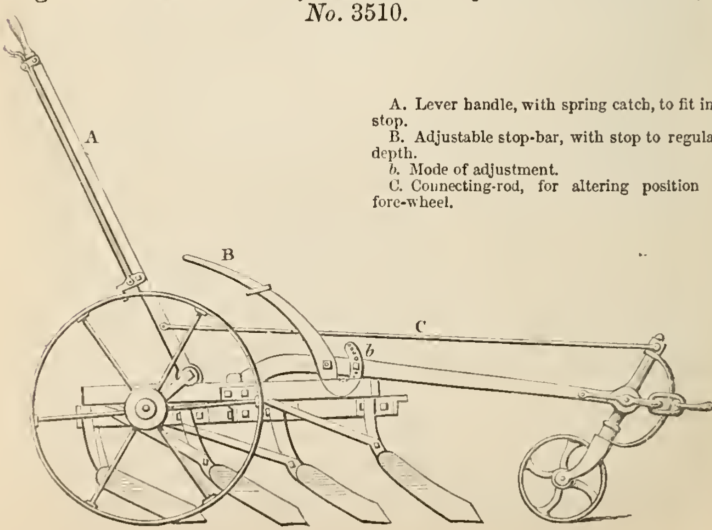
Fig. 103.—*Plan of Messrs. Murray and Co.'s Cultivator, No.* 3510.



A. Bolt for securing rigidity in work.
B. Circular frame.
c. Angle-iron bar to which tine bodies are bolted.
d. Axle carrying crank arms, and to which the beam
E is braced.
f. Radial breasts.

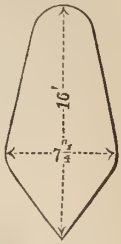
Fig. 104.—*Side Elevation of Messrs. Murray and Co.'s Cultivator, No.* 3510.

A. Lever handle, with spring catch, to fit into stop.
B. Adjustable stop-bar, with stop to regulate depth.
b. Mode of adjustment.
C. Connecting-rod, for altering position of fore-wheel.



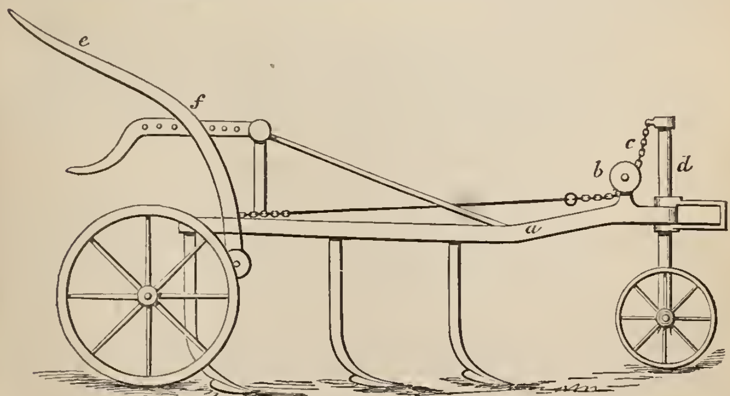
advantages claimed for this peculiar breast and point are, that no matter at what angle the lower frame is fixed, the diamond point and a sharp cutting edge is always facing the work. The action of the radial breasts is to lift the soil and leave it particularly light, and in a favourable condition for atmospheric action. In dirty land there is no possibility of choking, and the weeds run up the face of the breasts, and owing to the twisted form they clear well: this answers well for certain operations, but before Mr. Murray's cultivator can be made adaptable to a variety of different conditions, it must be furnished with additional tines and shares, such as narrow chisel points, broad flat shares, &c. The crank axle also requires alteration, being too long and weak. The travelling wheels are 2 ft. 10 in. diameter, with wrought-iron $\frac{5}{8}$ spokes and $2\frac{1}{2}$ in. rims. The price marked in the catalogue is 10*l.* 10*s.*

Fig. 105.



Corbett and Peele. No. 2855.—This firm exhibited similar implements in both classes of cultivators, differing only in the substance of iron employed in the frame; this was not sufficiently strong for heavy land, but the article under review, which competed in Class 27, was much noticed by the Judges, and one of the four selected for final trial. The chief novelty consists in the arrangement for lifting the frame, which is effected by a crank axle of hind wheels, and by a leverage on the fore-wheel carriage arm; a chain attached to the top of this arm runs under a pulley-wheel on the cultivator frame, and terminates by a rod on the lever arm from the wheel axle; by pulling down the lever arm the fore part of the frame is raised, by the chain lifting it up; and the travelling wheels are brought forward into a vertical position, by which the hind portion of the frame is raised. Depth in work is regulated by fixing the lever handle by a pin or stop bar. The following sketch (Fig. 106) made in the field, and not drawn to scale, will give a better idea of the mechanism.

Fig. 106.—*Messrs. Corbett and Peele's Cultivator, No.* 2855.

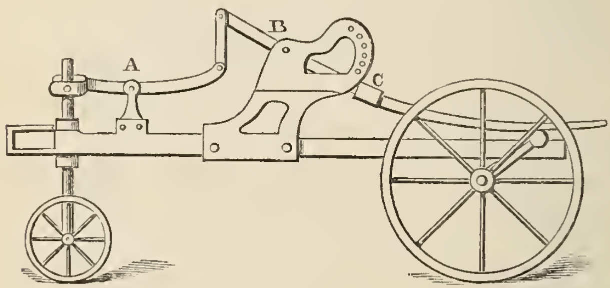


The drawing shows the implement as at work; *a* is a side elevation of the frame; *b*, the pulley-wheel working in a bracket or frame under which the chain, *c*, travels; *d* is the front wheel arm to which the chain is attached; *e* is the lever handle; *f* the stop bar.

W. Hunt. No. 1636.—Here again we have an ingenious leverage, which will be understood by reference to Fig. 107, p. 600. The principle is much the same as in Corbett's implement, viz., the lever handle acts upon the front wheels at the same time that it alters the position of the crank axle of the hind wheels.

A stud or pin in the front wheel arm holds the end of the first lever, whose fulcrum is shown at A; the second lever passes through a strong central bracket, or standard, its fulcrum being the point of attachment at B, the hinder portion of the bracket being pierced with pin-holes allows of the lever being held in place when raised out of work, and a spring, C, in the lever handle locks the lever in work. It will be seen by the drawing, which repre-

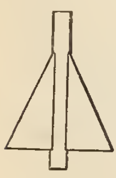
Fig. 107.—*Illustrating the leverage in Mr. W. Hunt's Cultivator, No.* 1636.



sents the cultivator at work, that the lever arm of the second lever is raised when the frame has to be taken up, and the arm of the first lever is similarly depressed. The power required is very small, owing to the mechanical advantage of the leverage.

This implement carries seven tines, capable of being fitted with different shaped shares, according as the object is cultivating or broad-sharing. The form of share used during trial combined both the point and the wing, and represents one of the most useful of the series (see Fig. 108). The frame, which is of wrought iron, is intersected with strong angular braces, and the slots for the insertion of the tines are solid and strong.

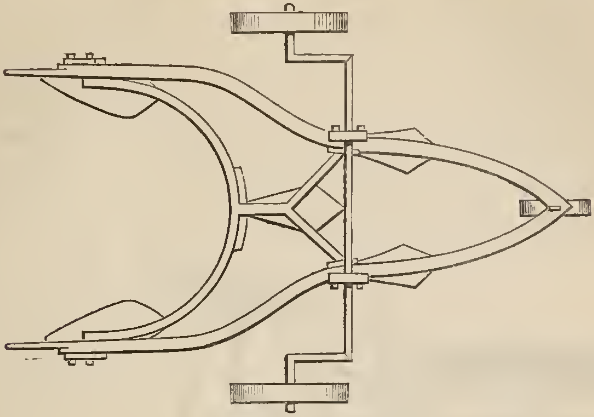
Fig. 108.



Murray and Co. No. 3511.—This cultivator has a construction totally different from that of the one exhibited in the lighter class; the frame, composed of curved iron bars, is not adjustable, but very strong and rigid, both on account of the strength of material used and the way in which it is braced. The radial breasts are employed, but the arrangement is different; instead of following one another, and all being twisted in the same direction, we have one central breast—two in front and two behind, and these pairs are twisted in opposite directions, and thus throw up the land in small ridges. The Judges were much pleased with the nature of the work, and considered it would be of essential use on strong land.

Fig. 109 shows a plan of this cultivator, not drawn to scale or absolutely accurate, but sufficiently so to give an idea of the construction of the implement. The five radial breasts are shown in about the positions they would occupy. The leverage for turning at the land's-end is not shown, but can readily be understood as acting on the crank arms of the travelling wheels. Price, 12*l*. 12*s*.

Fig. 109.—*Plan of Messrs. Murray and Co.'s Cultivator, No.* 3511.



For the Results of the Dynamometer Trials of the Cultivators see Table VII., which is printed at the back of Table IV., facing p. 588.

AWARDS.

CLASS 27.—*Cultivators for Light Land.*

473.—First Prize of 15*l.* to Charles Clay, of Wakefield.
3093.—Second Prize of 10*l.* to Coleman and Morton, of Chelmsford, Essex.

CLASS 28.—*Cultivators for Heavy Land.*

478.—First Prize of 15*l.* to Charles Clay, of Wakefield.
1637.—Second Prize of 10*l.* to William Hunt, of Leicester.
3095.—Highly Commended, Coleman and Morton, of Chelmsford, Essex.

CLASS 29.—*Broadshare.*

479.—The Prize of 10*l.* to Charles Clay, of Wakefield.
3095.—Highly Commended, Coleman and Morton, of Chelmsford, Essex.

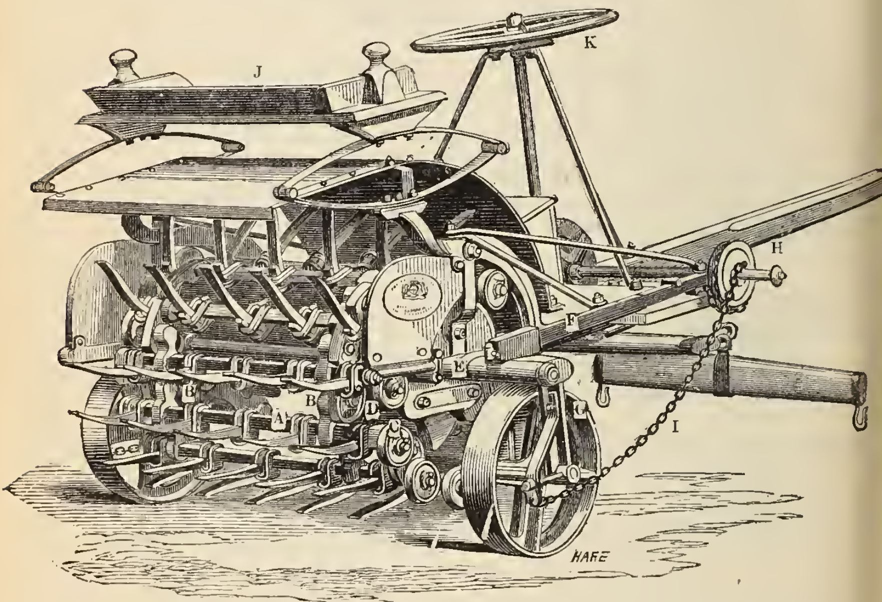
CLASS 30.—*Cultivators or Scarifiers.* Implements not qualified to compete in the preceding Classes.

480.—First Prize to Charles Clay, of Wakefield.
1184.—Second Prize to W. Ball and Son, of Rothwell, Kettering, Northamptonshire.

Section V.—Digging Machines, Class 31.

One entry, namely, Comstock's Rotary Spader, No. 1252, manufactured and exhibited by Messrs. Porter and Co., of Lincoln. This implement was, we believe, first exhibited at the Bury Meeting in 1867, when it was submitted to trial by the Miscellaneous Judges, who, however, made no award. In light soils the tines or diggers enter the soil readily, disturb the land to a considerable depth, as much as 6 or 7 inches if required, and leave it in a finely-pulverized condition. As we had not an

Fig. 110.—*Comstock's Rotary Spader, No.* 1252.



A. Transverse bar carrying the diggers.
B. Links at end of transverse bars forming endless chains.
C. Rollers on short arm of transverse bars, which work over cams to give the necessary pitch to the diggers.
D. Chain-wheel fixed on main axis of machine.
E. Main axle forming fulcrum for bell-crank F and G.
H. Hand-wheel.
I. Counter-chain.
J. Spring seat for driver.
K. Steerage-wheel.

opportunity of examining this machine, we reproduce an account which appeared in 'Engineering' of September 1867, and, by the aid of the illustration (Fig. 110), trust to convey some idea of the mechanism and mode of operation, which is very ingenious:—

"The digging portion of the Spader consists of a number of forks or prongs fixed to a series of transverse bars, which are connected at their extremities by links, so as to form an endless chain. This chain is led over chain-wheels fixed on the main axis of the machine, and, as the latter is drawn forward, the forks are successively forced into the ground. The ends of the transverse bars carry short arms provided with rollers, which work over fixed cams, these cams being something of this ∩ shape. The effect of the cams is to give the prongs a motion somewhat resembling that of the floats of a feathering paddle, causing them to enter the ground fairly, and to tilt over as they rise from it, and thus thoroughly break up the soil. When the machine has to be turned, or whilst it is being moved from place to place, the diggers are raised clear of the ground by a simple lifting arrangement designed by Mr. Porter. The travelling-wheels are carried by the shorter arms of a pair of bell-cranks, placed one on each side of the machine, these arms lying horizontally when the machine is in work, at which time the longer arms stand vertically. The upper ends of the longer arms are connected by chains to a pair of small drums, placed on a shaft carried across the front part of the machine, this shaft being capable of being rotated when required by means of a hand-wheel acting through bevel-gearings.

"The main shaft, carrying the wheels around which the diggers travel, passes through the angles of the bell-cranks, and thus forms the fulcrum on which the latter work. When the diggers are to be raised clear of the ground, the longer arms of the bell-cranks are, by means of the chains and hand-wheel, hauled down into a horizontal position; this operation bringing the shorter arms vertical, and causing the wheels carried by them to take the weight of the machine. By turning the hand-wheel the other way, the machine can be readily lowered again, counter-chains serving to bring the bell-cranks into their former position."

The friction of the endless chain passing over the chain-wheels appears to be very great, judging from the noise, and we should anticipate serious wear and tear. No tests as to draught were applied, as the Judges decided to withhold any award. The machines are made in three forms. No. 1, for light land, costs 35*l.*; No. 2, for strong soil, taking the breadth of four ploughs, costs 45*l.*; No. 3, adapted for steam-power, costs 120*l.*

Section VI.—Potato-ploughs (Cl. 32), and Diggers (Cl. 33).*

The trials of these implements were postponed until September 30th, when they took place on the farm of Mr. John Wells, at Booth Ferry, Howden. Out of six implements entered to compete in Class 32 and five in Class 33, only three of the former and two of the latter were eventually sent to trial. One of the Judges, Mr. T. P. Outhwaite, was prevented from being present at the trials, which were therefore conducted by Mr. T. C. Booth, of Warlaby, Northallerton, and Mr. J. Hemsley, of Shelton, Newark. The ploughs were first tried upon a plot of Regent potatoes with the tops quite dead, but with a considerable quantity of chicken-weed upon the surface. They were then taken to a field bearing a splendid crop of Paterson's

* The Report on Section VI. has been compiled from information furnished by Mr. Booth and Mr. Hemsley.—Ed.

Victoria potatoes, the tops of which were not ripe and very rank; but unfortunately, on being raised, the tubers were found to be extensively diseased. In Class 32, the Prize of 10*l.* was awarded to *Messrs. Corbett and Peele*, for their plough, No. 2858, having a single mouldboard, and fitted with their "Little Wonder" revolving fork (see description and figure of article, No. 2849, p. 578), the price complete being 8*l.* A "High Commendation" was also awarded to *Messrs. Corbett and Peele* for their double-mouldboard plough (No. 2857), fitted with two revolving forks, price 8*l.* complete. The Judges attached the "Little Wonder" revolving fork to an ordinary plough for raising potatoes, and found it a very useful addition, making a saving in manual labour, owing to its breaking up the ridge ploughed out, which therefore would not require to be scratched down by hand. It was also considered a great advantage to have the tubers placed, as by the single-mouldboard plough, all in one heap, being then more conveniently placed for gathering than when thrown out on both sides by the double-mouldboards. The single-mouldboard plough was further regarded as better adapted for ploughing all the roots up, in the event of it not being convenient to gather them immediately after ploughing. No award was made in Class 33, for the best machine or digger for raising potatoes; but the Judges think that one of the implements brought to competition is capable of improvement, though at present only useful on light soils when very clean.

Before concluding the Report, I venture to draw attention to the highly instructive facts deducible from the dynamometric trials, particulars of which have been furnished by Messrs. Easton and Anderson, the Consulting Engineers. Reference to the report of trials of steam-cultivating machinery at Wolverhampton, in 1871, affords a comparison of the relative power required to execute a certain amount of work by implements driven by steam-power, by double and single-furrow horse-ploughs and other implements, and thus gives a relative idea of the economy of the different implements:—

	At Barnhurst.	At Stafford.
The average ft.-lbs. of work indicated per lb. of earth dug or ploughed by steam	17·7	21·7
The average ft.-lbs. per lb. of earth cultivated ..	15·2	20·3

It must be borne in mind, in making a comparison, that the results are affected by the nature of the soil, and therefore the greater amount of power expended at Stafford where the land was strong, in doing similar work, than at Barnhurst, where the soil was comparatively light:—

Implement.	No. of Field.	Ft.-lbs. per lb. of soil moved.
Medium double-furrow ploughs	No. 1	12·08
Heavy ditto	Do.	13·5
Single-wheel ploughs	Do.	17·3
Single one-way plough	Do.	15·45
Double-furrow one-way plough	Do.	16·45
Pulverizers	Do.	16·38
Single-wheel ploughs	No. 4	13·87
Swing ploughs	Do.	15·
Light-land cultivators	No. 1	9·30
Heavy-land ditto	Do.	9·58

These figures may be considered as heights in feet to which every pound of earth moved should be raised in order to represent the work done. The only discrepancy in the above appears in the trial of single-wheel ploughs in fields Nos. 1 and 4. We should have expected exactly opposite results, since the soil in No. 1 was the lightest.* However, taken as they stand, without attempting to explain this anomaly, these figures are very significant of the relative advantages of double and single-furrow wheel-ploughs, and of wheel and swing-ploughs. If we compare, for example, the lighter double-furrow and the single-wheel plough in No. 1 field, the difference in favour of the double-furrow plough is as nearly as possible twenty-five per cent., and we are inclined to regard this as correct, since it is confirmed by some experiments at the Caistor ploughing match on the Lincolnshire Wolds in 1871, which gave—

The average of the three best double-furrow ploughs ..	10·6 ft.-lbs.
The best single-wheel plough on the ground	14·91 „

* In reference to the above, Mr. W. E. Rich, who looked after the working of the dynamometer, offers the following explanation, he says: "I believe the fact of the ft.-lbs. of work per lb. of earth moved being larger in No. 1 field, on vetch stubble, than in No. 4 field, very hard second year's seeds, which does at first sight seem strange, may be satisfactorily accounted for. In No. 4 field, which was cracked and very hard-baked by the sun, the occasional draught on the ploughs was extremely severe, but was never long continued, and was nearly always succeeded by very light draught, as the obstructive mass of earth gave way, and broke out in large brittle flakes, sometimes one foot long; we noticed this in No. 4 field very much. The dynamometer disc was constantly jumping backwards and forwards with the variation of load from very heavy to very light draughts; the result, however, proved always that the *mean* draught was less than in No. 1 field. If I am right in my opinion, a plough is more liable to fracture, and the horses have to submit to more jerking and occasional very heavy draught, in a field baked dry and hard with sun-cracks, than in a milder and moister clay soil; but the actual work done by the horses in the dry hard field will be less than the soft one—in the one it is ploughing glass, and in the other india-rubber."

Experience has proved that double-furrow ploughs are most applicable to light and medium soils, and it is easy to understand that the advantages in economy would be more marked under such favourable conditions than when tried on comparatively strong land. The fact that swing-ploughs consume more power for a given amount of work than wheel-ploughs is probably owing to their being less steady in work, and is a strong argument against their use; indeed, looking at this fact, and the greater skill necessary for their management, one is at a loss to imagine arguments in their favour, save under exceptional conditions, such as the sticky condition of the land, causing the wheels to clog and drag, and under such circumstances the attempt to execute work at all is probably a mistake.

The comparison between the dynamometer trials at Hull, and the indicator returns at Wolverhampton, is defective to this extent, that the conditions under which they were taken differed materially; thus, in the former, the dynamometer was placed between the implement and the rope, whereas in the latter the friction of the rope was recorded in addition to the actual work of the implement. Of course it may be said that the distance of the implement from the power is a feature of the system; but, though this is so, it must not be forgotten that the experiments at Hull were carried out by steam-power, a more steady draught than that of horses, and consequently the records were more favourable than would actually be the case in practice.

XXIII.—*Report on the Trials of Combined Stacking-Machines and Miscellaneous Implements at Hull.* By Charles Gay Roberts, of Shottermill, Haslemere, Surrey.

In the Report on the trials of implements last year at Cardiff, it was stated that the trials of the threshing-machines consumed so much of the time allotted to judging that it was impossible to give the stacking-machines as full a trial as they deserved. In compliance with a suggestion made last December at the general meeting of the Society, the Council offered this year a special prize of 25*l*. for a "Combined Stacking-Machine; to be tried with sheaf-corn, hay, and loose corn and straw, and worked by horse-power; and adapted for use in conjunction with a steam threshing-machine, if required." This repetition of the trials was fully justified by the result, for, in spite of the counter attractions of the Vienna Exhibition, there was a much larger entry than we had at Cardiff for the same class of implements.

At Cardiff, 13 elevators to be worked by horse-power were entered by 11 exhibitors; 10 of these machines were brought to trial, but, as 3 of them were pitchforks raised by ropes, there were only 7 machine-elevators competing for prizes. At Hull, 31 entries were made by 15 exhibitors, and though some of these were withdrawn as being virtually duplicates, there remained for competition 15 machine-elevators by 12 exhibitors.

The four other small implements that acted as pitchforks were not fitted for use in conjunction with a steam threshing-machine, and should not therefore have been entered in a class for *combined* machines.

This great increase in the number of entries corresponds to the very rapid increase that has been noticeable within the last twelve months in the general use of such machines upon the farm. Although on some railways two truck-loads instead of one have been charged for each elevator, and on other lines the rise in the ordinary rates of carriage have told heavily against their transit, yet the elevators have lately been common objects at most goods stations. We were, however, told by some exhibitors that the high rates had almost stopped sales far from the works. If it should be the case that the makers are thus brought to rely chiefly upon a local demand, it is clear that a very great public advantage may be obtained by their competing together on the trial ground; and after the trial more than one of the unsuccessful competitors expressed satisfaction at having entered for it, as they now saw how they might introduce many improvements in their own elevators. The trials were superintended by Mr. W. J. Edmonds, the Senior Steward, and were conducted by Messrs. Henry Cantrell, Charles G. Roberts, and Matthew Savidge, all of whom had been connected with the trials in this class last year; two of them as judges and one as reporter. Mr. William Anderson acted as Consulting Engineer; while his colleagues, Messrs. Rich and Wilson, rendered much valuable assistance throughout the trial by obtaining much of the information embodied in the first part of the table of results facing page 612. The trials were conducted in the rickyard of the Priory Farm, near Hessle, in the occupation of Mr. James Dunn, whose nephew, Mr. W. Dunn, gave most efficient help to our Assistant Steward, Mr. Elphick, in superintending the horse and manual labour needed to bring up and remove the implements, and secure a constant supply of hay, straw, and corn, for testing.

On the morning of the 7th July, at a consultation among the Stewards, Judges, and Engineer, the following scale for points of merit was adopted, and a copy affixed at the entrance of the rickyard.

POINTS OF MERIT.

	Perfection being.	Points awarded.
Weight	50	..
Price	100	..
Maximum height at which it will deliver	50	..
Stability, strength, and mechanical qualities. (Engineers' opinion)	200	..
Simplicity. (Engineers' and Judges' opinion)	150	..
Mechanical efficiency and freedom from friction	150	..
Absence of tendency to shake out corn	50	..
Completeness of delivery of straw, &c., and absence of choking of chains and forks	100	..
Protection from action of wind, tending to scatter the straw, &c....	50	..
Delivery at any angle	50	..
Size when packed	50	..
Totals	1000	..

NOTICE.

Each machine is to be brought to position folded as for travelling.

A first trial will be made with each machine with hay and straw not weighed.

A second trial will be made with each machine with numbered sheaves of corn.

Final trials will then be made with selected machines with weighed sheaves of corn, and, if considered necessary, with hay and straw again.

At the same time experiments will be made to determine the power required.

Each exhibitor had thus an opportunity of ascertaining beforehand the exact nature of the trial that would be made. In order to test the elevation of each machine and the cleanness of its delivery, an arrangement of poles and rick-cloth was made in the rickyard, as shown in the illustration (Fig. 1), where the rick-pole on the right hand is marked with a scale of feet, a rick-cloth is thrown across the horizontal bar, and a rope from each end of this bar is passed over a pulley at the top and fastened near the base of the upright pole. By means of these ropes the horizontal bar was set to any given height, representing the height of the stack; all hay or corn that dropped to the right of the cloth was counted as put fairly upon the stack, all that fell to the left was counted as wrongly delivered.

In Table I. are recorded the observations made, and the results obtained, during the three trials of each machine with hay, straw, and sheaf-corn, respectively. Fifteen machines were tried, but as one of them failed in each run it is not entered in the Table.

The machines were parked outside the rickyard. Before bringing it into the yard each one was folded up as for travelling or putting away in a shed, and its extreme height, length, and breadth were measured. These dimensions are entered in column

Fig. 1.—*Illustrating the mode of Trial of Stacking-Machines at Hessle Priory.*

14, and they determined the points of merit in column 30. The machine was then drawn into the yard, and placed opposite to the rick-cloth that had previously been hung 15 feet above the ground-level. The exhibitor was then told to have his men in readiness to adjust the machine for work. Two men were employed for this purpose by each exhibitor, except the one last on the list. In that case one man did all the work; but, though interesting as showing what could be done single-handed, the performance would have been quite as satisfactory if two men had done it in half the time; for, however short-handed a farmer may be, he will find it better to employ two men at least to set the machine and its horse-gear ready for work. At a given signal the men began to fix the horse-gear and to unfold and raise the trough 15 feet high; the time thus occupied is recorded in column 17, and, in conjunction with the construction of the machine, determined the points of merit in column 25, in which "simplicity" must be understood to mean such ease in working as would enable ordinary farm labourers to work the machine successfully. Some machines require many bolts and nuts to be adjusted by hand; in ordinary practice these nuts, as well as much valuable time, would probably be lost.

As soon as the machine was adjusted for work, a small waggon-load of loose straw was drawn up and unloaded into the hopper of the elevator by two men; an empty waggon was placed on the farther side of the rick-cloth to receive the straw as it came over, this waggon when full was drawn round to supply the same straw again (with the addition of a small pitch to make up for waste) to the next machine tried. When one-half of the load had been carried over, the trough was raised to deliver 20 feet high, and when another quarter had gone the exhibitor was told to raise the trough to the extreme height at which he thought it could do its work with thorough efficiency.

When the straw was all delivered the time occupied was noted, and a similar load of hay was brought up to be delivered at the same extreme elevation. Although the time occupied in each of the first three runs is noted in columns 18, 19, and 20, no points were awarded for rapidity of work, for most of the machines delivered the material as fast as it was supplied, and the supply was not quite at one pace; for convenience the same two men worked alternately at loading and unloading the same waggon, and before long one pair of men showed themselves quicker workers than the other two. In the trials with hay and straw most of the machines did their work fairly, and only one (No. 4952) broke down, owing to the bad construction of its horse-gear. The chief difference in these trials was in the completeness of the delivery and absence of choking of chains and forks; with some machines the straw and hay rolled back towards the hopper, and in others it hung upon the chains and teeth of the travelling ladder, so that much was dropped on the wrong side of the rick-cloth. The first fault, that of rolling, generally showed itself most in the lower half of the trough, and as it occurred chiefly in machines with short teeth and with the rake-heads set rather far apart, we at first attributed it solely to these causes; this explanation, however, did not seem satisfactory when we found Holmes (No. 4392) making a perfect delivery with teeth only 4 inches long. A further examination proved that this tendency to roll the straw in a great measure depended upon the position of the back of the hopper.

The back of the hopper should be made to point toward the spindle of the drum, as shown in Fig. 2, p. 611; the straw would then fall at once upon the rakes of the ladder, and be borne away in a straight line without twisting. When the back of the hopper is made to terminate behind the spindle, as in the lower sketch, part of the straw lies dead in the hopper, and as the rakes catch it before they are working in a straight line, it

Fig. 2.—*Correct Position of the back of the Hopper in relation to the Spindle of the Drum.*

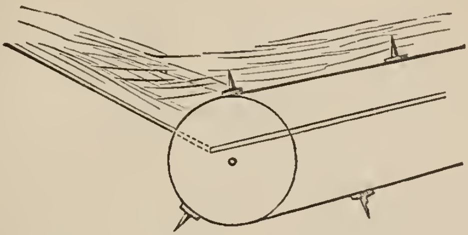
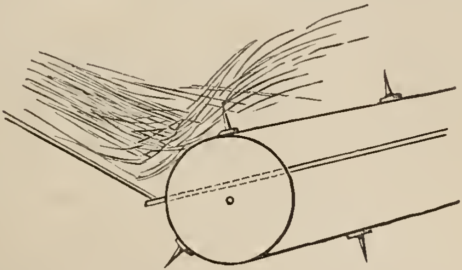


Fig. 3.—*Faulty Position of the back of the Hopper, causing twisting of the Straw.*



becomes partially rolled up before it starts, and is the more likely to roll back during its transit. In the case of Taskers' (No. 4839), the rolling back occurred at the top of the trough, and was due to a curve upwards in the trough itself, the upper division being too tightly braced up. When straw and hay were brought back and dropped under the machine instead of upon the rick it was generally due to one of two causes, either the shape of the chains and rake-heads afforded lodging places for the material, or else the ladder was driven at too great a speed, and the hay, instead of dropping perpendicularly as soon as the teeth were inverted, was swished down obliquely. The bad results of the quick motion were still more clearly seen in the trial with sheaves, for the rattle of the quick moving ladder in Nos. 169 and 5104 tended to shake out the corn, and when the sheaf left the top of the trough, instead of dropping soberly down, it was usually sent spinning, like a clown turning somersaults in the air. The trial with sheaves was in almost every respect a more severe test than with hay and straw; three machines failed to get through the work, and one or two of the others were choked up for a time by a rapid supply of sheaves.

Before describing the machines it may be well to glance over Table I. and note its chief points of interest. It will be seen that the points of merit awarded to each machine have been printed in detail under each head. This has been done, notwithstanding the caution once given to a newly appointed colonial judge—"Give few reasons for the judgments you pass. The judgment may be right though the reason may be faulty;" for, in a class of machines greatly varying in design and execution, some advantage may be derived from thus pointing out to each exhibitor what were considered to be the strong and the weak points in his machine.

In comparing the columns of points, however, with the earlier columns of facts that evidently should be considered as affecting them (as 3 with 22, 9 with 23, 6 and 7 with 28, and 14 with 30), the reader must remember that in the course of actual trial certain other differences, though too small to be recorded, would influence the award of points.

In column 3 a single line suffices for the machines that have their horse-works fixed as an integral part of the machine below the frame, but two lines are used in other cases, the upper one giving the price of the elevator, and the lower the price of the separate horse-works. The question of price is of greater importance with implements like elevators, only used occasionally, than with those that are in constant employment. If we reckon that 15 per cent. should be written off annually as an allowance for interest and depreciation in value, this will amount to 7*l.* 10*s.* on a machine costing 50*l.* An elevator will take the place of two men on the rick after it has reached the height of about 8 feet. On a farm where a month's work is done in stacking hay and corn each year it may be reckoned that the elevator will for twenty days take the place of two men, costing 5*s.* each per diem or 10*l.*; to this may be added 3*l.* for labour saved in removing straw from the threshing of corn grown on the same farm; the total value of the hand-labour saved will thus stand at 13*l.* On the other hand, to the cost of the machine about 3*l.* per annum must be added for the horse-labour required to drive it for twenty days stacking corn and hay; in stacking straw it will be driven by a belt from the threshing-machine, and will require no horse. The total cost is thus estimated at 10*l.* 10*s.*, and the total saving at 13*l.*; but the advantage derived from the use of an elevator on such a farm is to be sought rather in the superiority of the work than in its cheapness. A machine costing 70*l.* must similarly be charged with 11*l.* 5*s.* for interest and depreciation, and, in the case supposed, the total cost would then stand at 14*l.* 5*s.*, slightly exceeding the cost of doing the same work by hand. Even on a small farm, where hand-labour is difficult to obtain, the high-priced machine will no doubt be found practically economical in quickening harvest work, especially in showery weather; but some such calculation as the above will often make a farmer anxious to find a good elevator at a moderate price. The Judges, therefore, in column 22, allotted 100 points of merit as the maximum, and were very much pleased to find the machines which gave the best results in the trials among those lowest in price.

In column 4 the weight of each machine has been entered as reported by the exhibitor. Some of these weights, however, proved to be merely guesses, and very inaccurate. The same difficulty that the makers had found at home we encountered at Hull; when at the end of the trial we sent off some of the machines to be weighed, the carriage frames were too long to go upon an ordinary weigh-bridge, and as there was no time to make the special arrangements that would have been required, we were reluctantly obliged to give no points at all for weight.

In column 5 the inside length and breadth of each trough are given. The latter varies from 4 feet to 4 feet 9 inches; for hay, straw, and loose corn the narrow troughs are wide enough, but sheaves of corn are often knocked about in a narrow trough, and will even sometimes be thrown over the sides. The difference in the length of the troughs is very remarkable, for we find no corresponding difference in the maximum height of their delivery (see column 9). The shorter troughs were generally worked at a much sharper pitch, and had rakes provided with long spikes; and it is obviously much cheaper to lengthen the teeth than the trough. It was very clearly shown by these trials that elevators provided with good chains and long teeth may be raised much nearer to the perpendicular than some makers seem to imagine. The longest trough of all (No. 4889, Robey and Co.) was 43 feet long, but was only raised to a very slight incline of some 27 degrees, so that its top was only 25 feet above the ground. If this was not done by mistake, it must have been necessitated by a faulty construction of ladder-chain and pitch-wheels, that would not bite with the machine set at a sharper angle.

No. 165 (Barford and Perkins) was set at the low angle of about 35 degrees; three other machines (Nos. 1455, 169, and 5164), fitted with short teeth and ladder-chains of the same pattern, were all worked at nearly the same angle.

The two machines (No. 4391 and 4392) exhibited by Messrs. Holmes and Sons, although their ladder-chains were formed of long links, were yet only raised to an angle of about 38 degrees. The teeth in this case (see column 7) are of the intermediate length of 4 inches. Most of the other machines, provided with long-link chains, driven by octagonal wheels, were worked at a much sharper angle, averaging about 45 degrees; two of these machines, it will be noted, obtained the maximum points (column 27) for cleanness of delivery. The machine which was worked at the sharpest incline was No. 5014* (S. Lewin); the angle in this case was about 53 degrees, but the delivery, though fair, was not perfect. We may thus learn from column 5 that a comparatively short trough, worked at an angle of 45 to 50 degrees, will be better, as well as cheaper, than a much longer trough, that will only work well at a lower inclination.

The depth of the trough, as recorded in column 6, indicates the protection afforded against wind. This is a point of considerable importance; for without sufficient protection neither hay nor straw can be properly elevated in windy weather. The weather was extremely favourable throughout the trials, which were necessarily conducted in the open air; the heavy clouds that often threatened only made it a matter of congratulation that the trials were not once interrupted by rain; had the heavy storm that fell on Saturday afternoon very shortly after they had been concluded occurred at any other time of the week, it would have stopped the work for the time, and probably have so changed the condition of the hay and straw that the comparison of results from each machine would have been more complicated than it was.

The absence of wind throughout the trials was at first regretted, as the Judges had little practical test to guide them in the points of merit awarded in column 28. On the other hand, *short* trials in gusty weather might have been rather misleading than otherwise, unless we had been able to test the force of the wind each time. There was, however, sufficient wind to show us that in troughs of the same depth straw was more apt to be blown away by the wind from a quick-travelling ladder with short teeth than from one with longer teeth moving more steadily. Protection from wind is secured in some machines by making the trough itself deep, and in others by adding movable wing-boards to a comparatively shallow trough. The Judges considered the latter arrangement the better.

If the fixed sides of the trough are deep, it will not fold up into a small space. In still weather a shallow trough may be used without wings, and generally a single board on the windward side will be sufficient. It is of importance that the trough should be light; its weight is unnecessarily increased by making it *permanently* deep enough for use in a strong wind.

In column 7 it will be seen that the crossbars or rakes of the ladder were set at distances varying from 1 foot 10½ inches to 5 feet 8 inches apart; the latter distance is much too great; it took the straw and hay up in large lumps exposed to the wind, instead of delivering it in an even stream. Each rake is furnished with teeth varying in number from two to four, and in length from 2 to 7¼ inches. All the four machines with very short teeth were driven at a great speed, and although placed at a low angle the hay frequently rolled back during its ascent; this would have been very objectionable in elevating loose barley or oats. All grain thus knocked out would fall on one spot, and be apt to heat in the rick. This tendency to roll back may, however, as we have already said, be partly due to the shape of the hopper, and not solely to the shortness of the teeth. The best work was done by the longest teeth, and the arrangement we like best was found in the two machines made by Messrs. Tasker and Sons, where the rakes were only 1 foot 10½ inches apart, each one carrying two long teeth, arranged like harrow teeth, so that the teeth in one rake follow in the spaces left by the teeth of its predecessor.

In column 8 it may be noted that the round are much better than the square-shaped hoppers; the former offer great facility for taking straw from a threshing-machine at any angle, and when made of wooden staves with iron hoops they combine great strength with simplicity and neatness. It may be noticed that two of the square hoppers are furnished with movable backs, the intention being that as the trough is raised the back board should be adjusted to preserve the same angle with the trough as before. This adjustment makes a fair show on paper, and an intending purchaser may suppose it will increase the efficiency of the machine, but we do not find it of any practical value. A fixed hopper of proper shape holds the straw equally well with the trough in any position.

Column 9 gives the height of the hopper, measured by dropping a line from its top edge to the ground; a second line dropped from the spindle of the top drum when set for its highest work gave the second line of figures in this column. It is desirable that the back of the hopper should not be much more than 5 feet from the ground; this is a common height for the side of a waggon; every additional 6 inches will therefore add to the work of the man in pitching off the last part of the load. In the two machines that stand first on the list the hoppers were removed previously to the trials, the straw, hay, and sheaves being simply thrown upon the bottom of the ladder; in these cases the height of the bottom of the ladder is therefore substituted for the height of the hopper. In column 23 the points of merit for Height of Delivery are recorded, but it will be seen that only fifty points are fixed as a maximum. The Judges were for a time doubtful whether it would be advisable to make any use of the column that had been thus headed. No previous intimation had been given to the makers of any standard height that might correspond to the horse-power among steam-engines, by which engines of the same nominal horse-power are tested against each other. The fairest method that occurred to us was to determine first what height would be considered satisfactory on the majority of farms throughout the kingdom, and then to give the machine that delivered to that height such marks as would leave a small margin of advantage to machines fitted to build stacks of the exceptional size that may be seen on a few farms in Lincolnshire and elsewhere.

In future, it might be well to offer prizes for elevators that will raise hay to some specified height.

In this trial it was assumed that a clean delivery of 25 feet high would meet the present requirements of most farms. As the use of elevators extends, the average height of our stacks may perhaps increase; but the maker who succeeds at 25 feet will generally be able to execute an order satisfactorily for a machine to deliver at 30 feet when needed.

In column 10 it will be noticed that six out of the fifteen elevators were provided with plain octagonal chain-wheel driving chains formed of long riveted links, varying from $5\frac{3}{4}$ to $7\frac{1}{8}$ inches from rivet to rivet. Among these six are found all the three machines that gained full marks in column 27 for completeness of delivery. As each of these long links leaves the upper octagonal wheel on its return journey, the joint of the rivet is straightened out with a sudden, slight jerk, which helps to shake off all hay or straw from the rakes; other chains with small links come off so smoothly from the upper wheels that straw and hay often remain hanging upon them. Two other machines (5527, Robson, and 5014*, S. Lewin) also had chains formed of long links, but in these cases the octagonal wheels were furnished with large teeth. Four of the machines, viz. the first three and the sixth on the list, were furnished with a chain composed of small links of steel wire, No. 6 gauge, turned over in hook shape, but not welded; these were driven by a chain-wheel with a notched groove. All chains are more apt to slip on the driving-wheel when the trough is high than when it is low; when the trough is quite horizontal the lowest point of the chain will be in the middle, at an equal distance from either wheel; but as the trough is gradually raised, the curve in the under side of the ladder-chains is brought nearer and nearer to the lower (driving) wheels; if there is much slack, or if the links are small, they will soon begin to slip round the wheels. In the description of Messrs. Taskers' elevator (No. 4841), there is pointed out a very ingenious and effective method of artificially keeping the curve of the slack chain midway between the upper and lower wheels, even when the trough is raised to its full height. In other machines, it is endeavoured to overcome the difficulty by screws, which keep the chain well stretched, but it must in this way be subject to a considerable strain to prevent any slackening in its return journey. The other varieties of chains and wheels were each of a different pattern, and will therefore be best described in treating of the separate construction of each machine.

In the three columns, 11, 12, and 13, that describe the travelling wheels, it may be noticed that a large proportion are of cast iron, and of small diameter; such wheels may suffice for moving a machine about the rickyard, but are not fitted for one that is intended to be frequently drawn from one farm to another over rough roads. All the wooden wheels may be reported as good, and among the iron ones three with wrought-iron spokes, viz. Holmes' (No. 4392), Ashby & Co.'s (No. 4676), and Taskers' (No. 4839) are very good; while among the cast-iron wheels Taskers' (No. 4841), protected by a half-inch wrought-iron tire, is by far the best.

The great distance between the fore- and hind-wheels that in some cases will be noticed as registered in column 13 must make those machines awkward to turn, but where the horse walks beneath the trough and between the fore- and hind-frames, as in the two machines at the head of this list, this distance cannot well be avoided.

Column 14 gives us the size of each machine when packed for travelling, or for putting away in a shed. The first dimension, that of height, was regarded as the one of most importance. A machine exceeding 9 feet in height cannot be put under an ordinary cart-shed. It is satisfactory to find a considerable improvement in the compactness of these machines since they were first introduced.

A very small *breadth*, on the other hand, cannot be considered good; when a strong side wind is blowing, a narrow machine working at the height attained by the one first on the list has an unpleasant appearance of instability.

Column 15 brings before us the important and much-debated question whether it is better to make the horse-power separate, or a fixed part of the machine working below the trough.

Among the advantages claimed for the latter arrangement is that it takes less time to prepare one than two machines for work, and it will be observed that in the trial a machine with horse-gear attached (No. 4391) took less time than any other (eight minutes) to adjust; but it should be also noticed that the four machines that took the next shortest time to adjust all had their horse-gears independent, while the machine that took far longer than any other (forty-seven minutes) had its horse-gear attached.

Although when each machine is first brought out from the shed folded up, one form will generally take as long a time as the other to set to work, yet after they are once opened it will take much less time to shift the self-contained machine from one rick to another than to move separately the independent machine and the separate horse-gear to work it.

These self-contained machines possess another indisputable advantage—they occupy less room in the rickyard. The horse working beneath the trough, and between the waggon and the rick, no further space is needed. With the other machines it is sometimes difficult, when the rickyard is nearly full, to find sufficient space for the separate horse-works. Another advantage that has been claimed for this form of machine is that the horse-power being applied more directly, there will be less of it lost in overcoming friction. The results of the last trial, however (given on Table II.), will show that in the machines subjected to mechanical tests this advantage was very small.

On the other hand, certain disadvantages must be noted against these self-contained machines. The hay or corn that falls from the waggon, the rick, or the machine, drops upon the horse-track, and in the course of a day's stacking a considerable quantity will be thus fouled by the droppings and treading of the horse. When a separate horse-gear is used, this inconvenience and loss is avoided. Another inconvenience is found in the height of the hopper; when the horse works below, the hopper must be placed higher than the side of a waggon; we thus give the man on the waggon a part of the work that we wish to save by the use of a machine-elevator. In the two machines first on the list, this difficulty was overcome by removing the hopper, but more hay and corn then dropped by the horse-track. Another objection that has been hitherto made to these machines, is that the horse-gear being beneath, they cannot be folded down low enough to go under an ordinary cart-shed; this difficulty, however, has been quite overcome in the case of the Beverley Iron Works machine, which folded down to 7 feet 7 inches, lower than any other machine in the trial. There is an advantage in having the horse-power separate, since on many farms it will be useful for chaffcutting or other work when not wanted for stacking.

Although the Judges were of opinion that the balance of advantages rests with the machines provided with separate horse-gear, yet the other form of machine has such decided merits that it will probably be preferred on many farms; it was, therefore, with great satisfaction that they found machines of both classes showing a great improvement in construction since they were exhibited last year at Cardiff.

In describing the machines it will be convenient to classify them according to the principles of their construction. I shall, therefore, leave the four with horse-power below the frame to be described last. Nine of the other eleven machines are carried upon four wheels, and the other two upon two wheels only; taking the four-wheeled machines first, it will be seen that three of them fold the upper part of the trough *down*, two of them slide it telescopically into the lower part of the trough, and three fold it over to lie flat upon the lower half, while in the ninth machine a net is substituted for the ladder and trough.

No. 4841. *Tasker and Sons.* This machine is in many respects a great improvement on the four-wheeled machine by the same makers, that was highly commended at Cardiff, and described and illustrated in last year's Report.* The trough now folds downwards instead of over, and is well braced with iron. A very simple arrangement for raising and folding it now takes the place of the complicated contrivance of poles and ropes then used. The carriage-frame is lighter, the hopper is round instead of square, and a clever device is adopted for keeping the ladder-chains taut. The trough is raised by the wire-ropes wound upon V-grooved pulleys, and fastened to the heads of the two movable shafts which terminate in friction-rollers; it will be seen that the bottoms of these shafts revolve upon the iron axle of the fore-wheels; this is an improvement on a similar arrangement shown last year in Messrs. Marshall and Sons' machine; the shafts there rested on the fore-part of the carriage-frame, and the chains at first starting worked at such an acute angle with the rods, that power was wasted, and the winch unfairly strained. The friction-rollers at the top of these shafts run beneath metal rails on the under side of the trough. At their lower extremities these rails are made to project from the under side of the trough; as soon as the shafts are drawn back far enough to reach the curved parts of the rails, the trough itself rises at a quicker rate, and the friction-rollers begin to act as pulleys to the ladder-chains, keeping the curve of the slackened chains away from the wheels that drive them at the bottom of the trough. In Fig. 4, p. 620, showing the machine unfolded, the trough is not raised to its full height, and the shafts must be drawn two or three feet further back before the rollers will reach the projecting parts of these rails. The wire rope that moves the shafts is wound upon a drum furnished with two V-shaped grooves; in the second of these another wire rope is carried tightly wound up when the trough is open. It will be noticed that the trough when opened is braced by means of wire ropes attached near its two extremities and carried over two short wood poles; when the trough is to be folded the lower end of these ropes is hooked on to the spare ropes in the second V-pulleys. The trough having been previously lowered, the handle is turned and the shafts are drawn up; the second ropes are then slackened out till the top of the trough hangs down and can be fastened to the axle of the fore-wheels, as shown in Fig. 5. In this figure the daughtsman has, by mistake, represented the hopper as square instead of round. Fig. 5 shows the machine folded for travelling short distances, but by lowering the shafts until their pulleys touch the joints of the trough it can be packed in much smaller compass for putting away in a shed. The trough of this machine is well braced, of ample width, and not too heavy; the round hopper formed of iron-bound wooden staves is

* 'Journ. Royal Agric. Soc.,' 2nd Series, vol. viii. Part 2, No. XVI. p. 450.

Figs. 4 and 5.—*W. Tasker and Sons' Prize Stacking-Machine, No.* 4841.

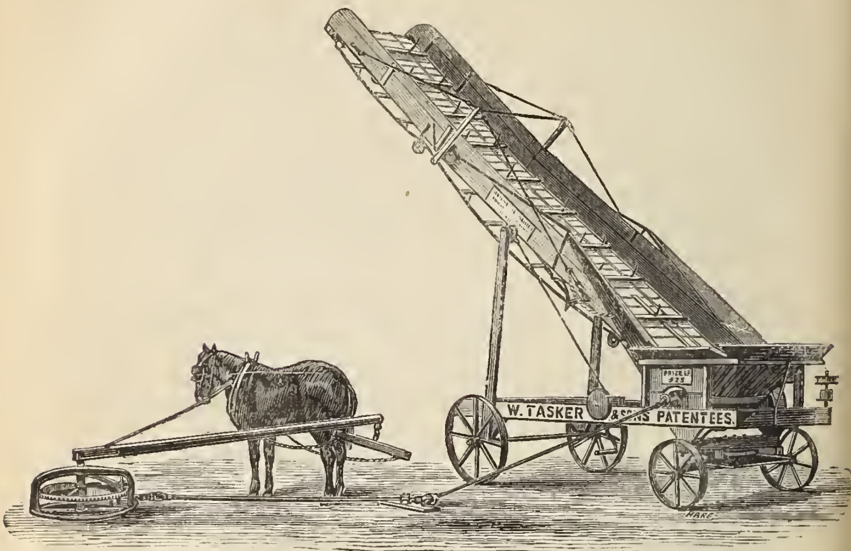


Fig. 4.—Machine ready for work.

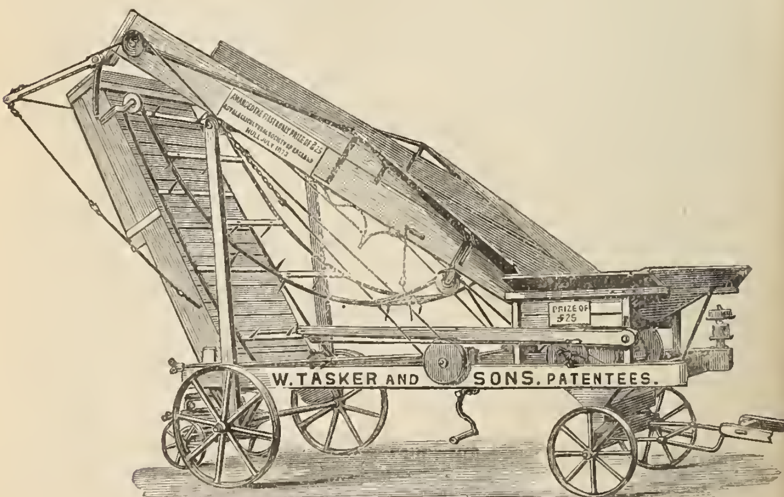


Fig. 5.—Machine folded for travelling.

of an excellent pattern, the oak carriage-frame is of great strength; the worm and cog-wheel for raising the trough and the joint of the shaft from the horse-gear are furnished with iron caps to prevent hay or straw from catching in them. The teeth are attached to the rake-heads by nuts and screws, and are forged with a collar that helps to keep them firm. The point most open to criticism in the machine is the size of the pulleys on which the wire ropes are wound, their diameter at the bottom of the groove is only $7\frac{1}{2}$ inches; it is not well to bend wire rope so sharply, and we would recommend that the pulleys should be made larger. With this single minor exception, the machine is of admirable construction and workmanship. Its price contrasts very favourably with those of many machines of inferior make.

No. 5588. *Wallis and Steevens.* The trough is here raised by a rack and

Fig. 6.—*Messrs. Wallis and Steevens' Stacking-Machine, No.* 5588.

pinion, on Hayes's principle, but to prevent these cast-iron racks from being broken by a lateral strain from the action of wind, or from a sudden jar when moving with the trough raised for work, two trussed oblique wooden shafts prevent the trough from swaying on either side.

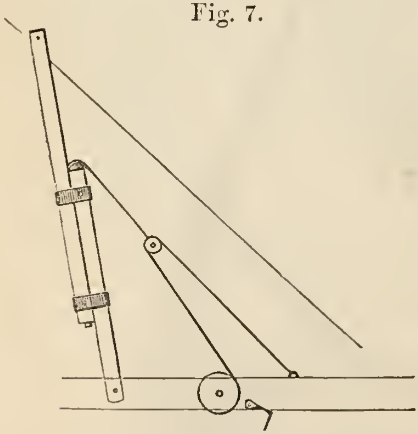
In opening the trough the upper part is disengaged from the carriage-frame, to which it is fastened when travelling; the trough is then partially raised by the rack and pinion; the upper part is then raised by a prop, which supports it at the farthest extremity; the main part of the trough is then lowered on the rack, till the joint between the two parts closes, and is kept fast by a self-acting hook-and-eye; three light iron rods form a truss to each side of the trough. Since the Cardiff Meeting, the rake-heads, teeth, and chains of this machine have been strengthened, and their mode of attachment improved; the teeth are now fastened by nuts instead of rivets, so that if one is accidentally bent, it can be taken out, straightened, and replaced in a few minutes. The back of the hopper can now be adjusted, so that its slope can be regulated to suit the inclination of the trough. The substitution of a round for the square shaped hopper would improve this machine, and enable it to take straw from a thrashing-machine at any angle.

A wooden hood is used in delivering hay and straw against a head-wind. In delivering sheaf-corn, a light hanging platform of long wooden laths was suspended under the top of the trough; the laths being free at their outer extremities, and placed with a forward dip, the sheaves as they fall upon them are lightly thrown forward, and are thus delivered well into the middle of the rick. The workmanship of this machine is good, the carriage-frame is of white deal, the oblique shafts are of oak.

No. 5527. *T. Robson.* This machine, although it failed in the trial with sheaf-corn, is much better in design than in execution. It contains some original contrivances, that show much ingenuity in the exhibitor, but he has apparently been unable to put his inventions in such a practical form as he might have done if he had command of a larger factory.

A new idea, though roughly worked out, is often of great public value, and for this reason its exhibition even in a crude form is to be commended. It will not, however, much benefit the exhibitor, except as a proof of ability that might otherwise be passed over without meeting with the encouragement it deserves. The top of the trough is made to fold under; it is opened out for work in a manner very similar to that described in the last machine, but is raised by an original contrivance of sliding rods, sketched in Fig. 7. A rope passes over a pulley at the top of the lower rod, then down a groove between two rods, and is fastened to the bottom of the upper rod; when this rope is wound up the upper pole slides up, and so raises the trough. Another device peculiar to this machine is a semicircular metal bearing at the back of the hopper, which supports a shaft that can be placed at any angle, and carries at one extremity a pulley to receive the belt from a threshing-machine, and at the other end terminates in a bevel-wheel, that drives the

Fig. 7.



shaft of the lower chain-wheels; these latter are octagonal, of cast iron, with long teeth, working into the double links of the ladder-chain. This chain of double and single links alternately might be recommended for its durability, but we are inclined to think a chain driven by a plain octagonal wheel, as used in the machines previously described, is better in principle.

Of the two machines with telescopic troughs, No. 1234 (*J. Coultas*, Fig. 1, p. 609) is in all the principles of its construction similar to the machine exhibited last year at Cardiff by Messrs. Clayton and Shuttleworth, which then took the first prize, and is described and illustrated on page 454 of the 'Journal' for 1872 (Second Series, vol. viii. Part 2, No. XVI).

On comparing the telescopic with the folding-troughs we may notice, that while the former possess some advantages in avoiding the use of hinges, yet, on the other hand, they occupy more space when packed. The ladder-chains to this machine are of common links, and driven by a skeleton-wheel. The upper chain-wheels, and all the guide-pulleys are grooved to keep the chain in a straight line. A wheel and pinion for quick motion were used in the horse-gear; although the ladder was driven at a higher speed than usual, it travelled smoothly; and the chief objection to the pace was that, in conjunction with the long *curved* teeth of the rakes, it had a tendency to spin the sheaves as they fell to the rick. The driving-rod from the horse-gear was well protected where it crossed the horse-track by passing it through a 3-inch gas-pipe. It is an advantage to have the trough light, but in this case the lightness has not been sufficiently combined with strength. In all other respects the machine is strongly made, and of good workmanship; the travelling-wheels are of wood. A hood is provided of wood and canvas.

No. 4889. *Robey and Co.* In its general plan this machine resembles the last, its trough being telescopic, the ladder-chain is also plain, and driven by a wheel with notched groove. It differs from it, however, in one important item, lightness of working parts has here been sacrificed to strength. The lower part of the trough is strongly framed of wood, but is too long and too heavy for the very moderate height attained in the trial. The total length of the trough is 43 feet, yet it was only worked to 25 feet, a height attained efficiently by Messrs. Wallis and Steevens' machine, with a trough only 28 feet 6 inches long. We found strength and lightness in troughs best obtained by the use of iron braces, wooden framing being often too heavy. The rake-heads were rather too heavy, and, instead of being flat, were made with an almost square section; this would produce a tendency to turn over in working, and to prevent this an extra chain passes down the middle of the ladder, each length of this chain is fastened to the under side of one rake, and to the upper side of the following rake. This contrivance effectually prevents the rakes from turning over, but it increases the draught of the ladder, which, from the low inclination and great length of the trough, must in any case have been heavy. The guide-rails, which in all other machines were continued down the whole length of the trough, and serve to raise the rake-heads about 2 inches from the floor, were omitted in the lower, and placed too far apart in the upper part; the consequence was, that the heavy rake-heads, knocking directly upon the floor of the trough, tended to thresh out corn in the trial with sheaves, and made the work very heavy for the horse. The middle chain was found objectionable also in the earlier trials, for hay and straw were caught by it, and delivered under the machine instead of upon the rick. The hood is formed of sheet-iron and wood. The workmanship throughout is substantial. An economy in price and horse labour might be obtained by using a shorter trough at a sharper pitch.

No. 5014.* *Stephen Lewin.* This machine is almost identical in all respects with the one by the same maker that obtained the second prize last year at Cardiff, and is described and illustrated on page 455 of the 'Journal' for 1872. The only points of difference are that the trough is 3 feet shorter, and five movable boards have been added to increase the size of the hopper, these boards, of half-inch deal hasped together, are not in any way an improvement, and were at once condemned as too slight to bear ordinary usage; the accidental backing of a waggon against the hopper in the course of the trial confirmed this opinion, by breaking this upper frame. If a well-made circular hopper had been substituted for this unfortunate contrivance, the points given for stability would have been considerably improved.

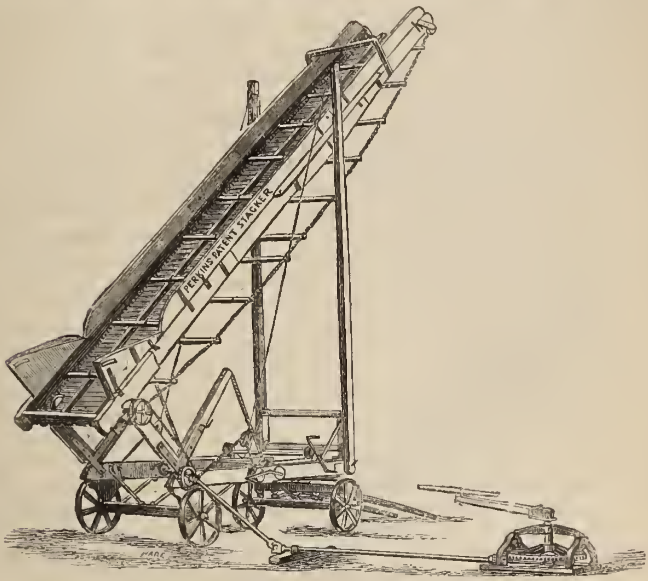
It will be noticed that this machine was adjusted for work by *one* man. The apparatus for raising and for folding the trough works with great simplicity, and has been described as of great strength, but adding considerably to the weight of the machine. A handle, placed upon a worm spindle, actuates a set of gearing that moves two toothed quadrants, fixed upon the base of wooden shafts; friction-rollers at the upper extremities of these shafts clip the angle-iron on each side of the trough. Spindles through the base of the shafts enable them to turn upon bearings fixed to a short frame placed above the fore-wheels. On comparing the columns 5 and 9, it will be found that this machine was worked at a sharper pitch than any others in the trial; although it did not obtain so high a position as it held last year, it will be seen that only three surpassed it in the total points of merit. The pleasure of finding one of the prize takers of last year courageous enough to enter the lists a second time, was lessened when it was found that the only change introduced was for the worse. In a class that is making rapid strides towards perfection, the competitor who stands still must quickly find himself surpassed. In this case I hope that a temporary failure will only stir to fresh efforts, resulting in new success.

No. 169. *Barford and Perkins.* In this, and the machine next to be described, the trough is divided by hinges into two equal parts, and in folding the upper half is turned over to lie upon the lower part. For folding and for raising the trough, hemp ropes are used, passing over a pulley at the top of vertical wooden shafts, rising from the carriage-frame on either side. The weight of the upper part of the trough rests entirely on these ropes; they ought therefore to be carefully tested at the beginning of each season, and it would be better to avoid the use of a perishable material by substituting ropes of iron wire, although these would require larger pulleys. The trough, and the ropes and poles required for raising it are precisely similar to those used in No. 165 machine, and illustrated in Fig. 10, p. 629.

An arrangement peculiar to this machine is provided to keep the shaft from the horse-gear nearly horizontal, and thus avoid the loss of power that results from the sharp inclination at which the length next the elevator is usually placed. Two light iron brackets beneath the carriage-frame carry a shaft on the same level as the shaft from the horse-works, to which it can be attached at either end; at its other extremity it carries a pulley, from which a short leather belt drives the shaft for the lower chain-wheels. The use of leather here is objectionable, the belt would be apt to slip in damp weather. The rounded hopper of sheet-iron provided by these makers is not equal in strength to the wooden ones, but is more convenient than those made square. A good form of hood is provided of canvas, stretched over iron rods. The short teeth on a quick-driven ladder have already been described, as inferior to longer ones with a slower motion.

No. 5104. *Perkins and Co.* This machine is very similar to the one last described, and it will therefore be sufficient to describe the points in which it differs. The chief novelty is a contrivance for raising the hopper and bottom of the trough, when required to work at a great height; this is done by fixing the driving-shaft, and the bottom of the trough, not upon the carriage-frame as is usually done, but upon the extremities of two wooden elbow-pieces, turning like bell-cranks, by means of rope and pulley upon bolts fixed to the frame, which pass through them at their angles. The shaft from the horse-works drives a chain-wheel at one of these angles, and a steel chain conveys the power to the ladder-shaft at the bottom of the hopper. This substitution of steel for leather is an improvement on the machine last described. While the rick is low the bottom of the trough is near the ground, but is raised from 3 to 7 feet higher by moving the crank. In the illustration given, Fig. 8, the top

Fig. 8.—*Messrs. Perkins and Co.'s Stacking-Machine, No.* 5104.



of the trough has been raised by the long ropes to its full height, the hopper has been removed, and the bottom of the trough is partly raised. As the hopper-end is raised, the delivery-end is pushed farther on to the stack. The cost of this contrivance is moderate, adding only 5*l.* to the price of the machine. Although the inclination of the trough was reduced by elevating its lower end, this was not sufficient to prevent the straw rolling back on its passage, owing to the shortness of the teeth. Towards the end of the trial with straw we had an illustration of the evil of driving the ladder-chains by chain-wheels with a small groove. The groove on one of the wheels was partially filled up by straw wrapping around it, thus increasing its diameter, and causing the chain on the *opposite* wheel to slip twice; the diameters of the wheels being made different, the two chains of the ladder travelled at different paces. To prevent the rake-heads from turning over, iron spurs were used; although they effected the purpose for which they had been added, they had the bad effect of catching the straw and dragging it back.

The two-wheeled elevators come next in order. The first of these (No. 4839, *Tasker and Sons*) is in all respects the same machine as was highly commended last year at Cardiff, and will be found illustrated and described on page 452 of the 'Journal' for 1872. It was not, however, shown in quite so good a form as last year, for the wooden slats then used as a protection from wind had been omitted, and the trough was curved by bracing the top part too tightly, so that straw rolled back when near the top of the trough. Sheaf corn was however fairly delivered. The workmanship in this machine is good.

No. 4676. *Ashby, Jeffery, and Luke.* The chief novelty in this machine is the attempt to substitute a single india-rubber belt for the two chains that usually carry the rake-heads; this form of ladder carried the hay and straw up fairly, but brought much back, hanging on the rake-head and long *curved* teeth. Faulty contrivance was at once apparent when the trial with sheaf-corn began; the loose grains fell upon the india-rubber belt, and getting between it and the smooth round pulley that drove it, caused it to slip so much that the trial could not be continued. One of the workmen crawled under the machine, and in attempting to correct the fault was caught by one of the rakes, the tooth going through the back of his waistcoat; a serious accident was feared, and everyone felt much relieved at the giving way, not of the waistcoat, but of the tooth, which broke out of the rake-head. A firmer attachment for the teeth would be an improvement for ordinary work. The trough is raised by ropes passing over the heads of upright wooden-shafts. It was stated that this machine had only been tried at home with hay and straw, but never with sheaf-corn. The Judges cannot too strongly impress upon exhibitors the importance of trying each machine thoroughly at home before it is entered for competition: a disregard of this obvious precaution must almost always be regretted, alike by judges and makers. This remark receives a still more emphatic illustration in the machine next to be described.

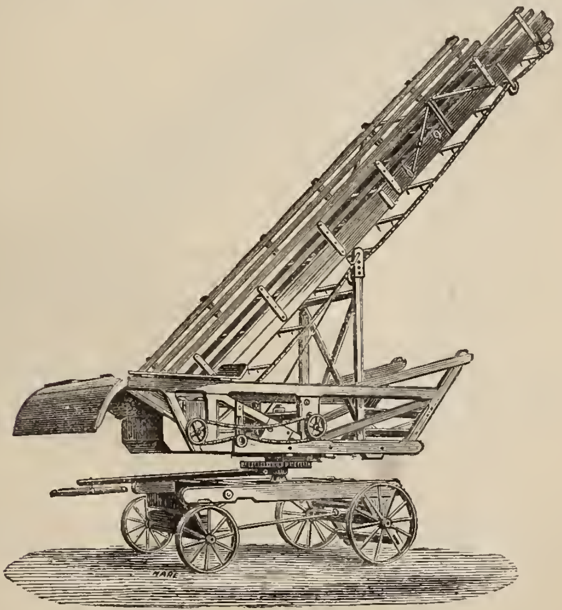
No. 4952. *Henry Wright.* The performance of this machine was most unsatisfactory in each of the trials. The horse-gear sent with it was from a new pattern, and had never been previously tried. It was soon found impossible to work it, and both the machines had to be withdrawn from the first trial with hay and straw. The elevator consists of a four-wheeled carriage-frame, with a wooden hopper; no trough is used, and a long revolving net takes the place of trough and ladder. Hemp-ropes form the sides of the net, and are carried over grooved driving-pulleys at the bottom, and grooved guide-pulleys at the top and sides of two long oblique ash-shafts; these shafts turn at their bases upon the carriage-frame, and are raised or lowered by ropes passing over the heads of two other shafts, raised nearly vertically from the carriage-frames. The oblique shafts are divided into two halves, and the upper halves slide down over the lower when packed for travelling. Each of the upright shafts was simply fastened to the frame by a bolt through its base, and was not in any way stayed, except by a cross-bar connecting it with its fellow at the top. The whole weight of the net and its oblique rods resting upon these upright shafts they soon lost their perpendicular position, and the whole upper framework threatened to fall over on one side. The snapping of one of the ropes that formed the side of the net soon brought the trial with sheaf-corn to an end.

It is much to be regretted that an untried machine of a new pattern was in this case entered for trial; the exhibitor has long been a maker of elevators, and it would have been instructive to compare a net-elevator with others, if it had been brought in a form fit for working. In this instance stability had been altogether sacrificed in an attempt at lightness of working. While the Judges condemned the machine tried, they must not be understood to condemn the system of employing a net instead of a trough and ladder, for the example entered was not brought out in a fair working form. From the very imperfect example tried, it was clear that a net could be worked at a low expenditure of power; in the trial with straw, the machine was easily worked by hand after the horse-power failed. The protection from wind was also better than was expected for the wind passing freely through *all* the meshes of the net, its force was not concentrated at any one part. When nets were first tried, the side-ropes were very apt to slip off the driving-wheels; this has lately been prevented by using cross-bars, placed at about the same distance as the rake-heads on other machines; the net forms itself into wide pockets between these bars, and thus holds the hay more firmly than in the plain net. The price of this machine, without horse-gear, is 45*l.*

There now remain to be described the four elevators with horse gear fixed below the trough. Of these I will take, first,

No. 4391. *Holmes and Son.* This machine is a very great improvement on the one constructed on a similar principle that was tried last year at Cardiff, and described on page 456 of the 'Journal' for 1872. The principal improvements are the substitution of a wrought-iron central pin, $3\frac{3}{8}$ inch diameter, for the cast-iron pin then used; the upper frame has been shortened at the feeding end, so that it is now fairly balanced upon the central pin, instead of being *tail heavy*, as it was before. The apparatus for raising the trough has also been simplified, and is now similar to that described in Messrs. Tasker and Sons' machine.

Fig. 9.—*Messrs. Holmes and Sons' Stacking-Machine, No.* 4391.



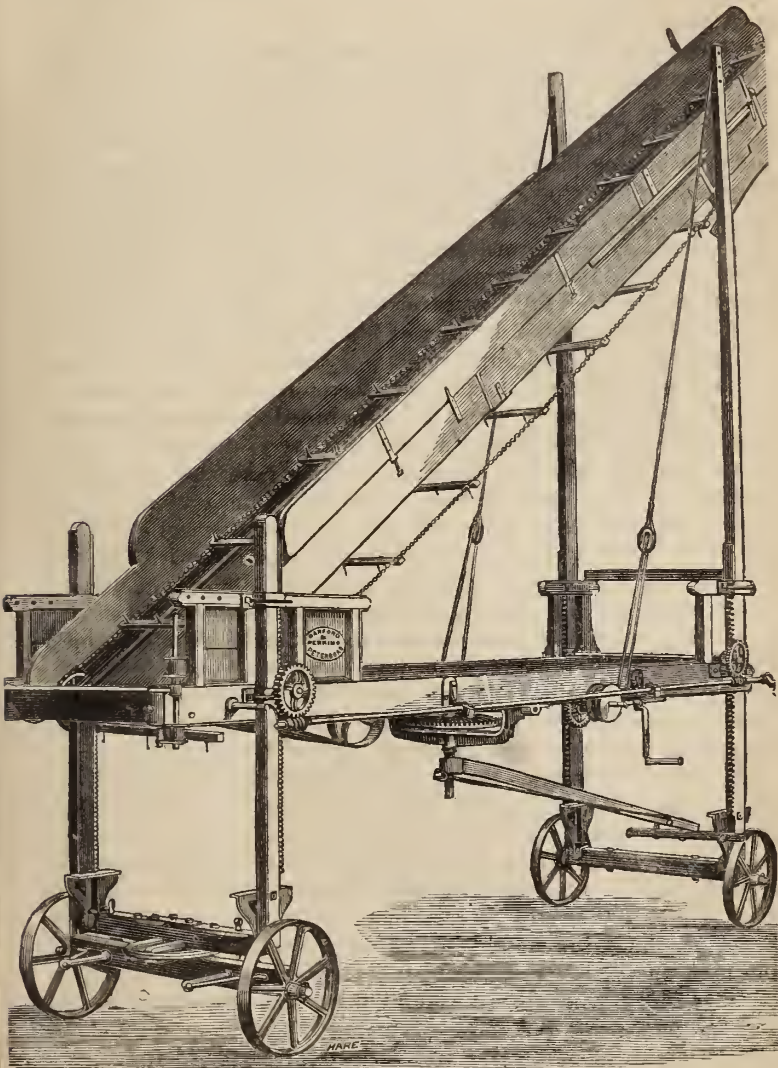
In its present form there are three distinct frames below the trough. First, a strong carriage-frame, on to which the frame of the horse-gear is bolted when used in stacking hay and corn. The horse-wheel drives a spur-wheel on a vertical shaft, which again drives a pair of mitre-wheels, and a horizontal shaft from the second mitre-wheel drives the pitch-wheel and chain, shown in Fig. 9, outside the third and upper frame, which carries the hopper and trough. After harvest, when the horse-power is no longer required, four long screws are substituted for the bolts that commonly hold the first and second frames together, by these the middle frame is gradually lowered through the carriage-frame till the top frame rests upon the lowest; the middle frame, with the whole of the horse-works, is then removed, and the two other frames securely bolted together. In this way the weight of the machine is lessened 10 cwt., the hopper is brought down to the right level for taking straw from a threshing-machine, and the amount of rigidity that is desirable when working by steam-power is fully secured. A fan-shaped expanding board enables the square hopper to take straw from the threshing-machine at any angle. Although the Judges preferred a round to a square hopper, there is perhaps some reasou for adopting the former shape in this and the next machine, for it will be seen that a platform is placed round the hopper to prevent hay and corn from falling on to the horse-path under the hopper. The upper part of the trough folds under, and is fastened to the carriage-frame when travelling. The rake-heads are well fastened by iron straps, which pass over the ladder-chains, and are held by short iron bolts. It will be noticed that this machine was set ready for work in less time than any other in the trial. When once set for work it can be moved from one rick to another with the greatest facility, and the point of delivery on any one rick could be shifted, if desired, each time a fresh waggon comes to be unloaded. The materials and workmanship throughout are very good, and the improvements introduced within the last twelve months have rendered this a very efficient and valuable form of elevator.

No. 4392. *Holmes and Sons.* This machine is lighter and has rather fewer parts than No. 4391, but its upper frame has not the same facility for revolving freely upon a central pivot. There is no independent carriage-frame, but the horse-works are placed round the upright shaft over the main axle. The horse-wheel drives a bevel-wheel on a horizontal shaft, which carries a toothed pitch-wheel; a link chain from this wheel drives the pitch-wheel on the shaft of the lower drum. The trough is telescopic, and is raised by racks and worm-wheel on Hayes's principle. When the trough-frame is raised to its full height for elevating hay and corn, it rests on these two racks and on the central screw; side stays are provided, but were not used in the trial. For travelling, two cast-iron brackets are provided to take the weight, when the frame is raised, off the central screw. When used with a threshing-machine, the trough-frame is lowered by means of the central screw. This machine is cheaper than the one last described, and packs into a rather smaller compass, but its mechanical construction is not quite so good.

The two elevators that remain to be described are of precisely the same pattern; the exhibitor of the second paying a royalty for its use.

No. 165. *Barford and Perkins.* From Fig. 10, p. 629, it will be seen that the horse-track in these machines is between the fore and hind carriage-wheels, while in the case of Messrs. Holmes and Son's machines (Fig. 9) the horse walked round outside the carriage-frame. Fig. 10 further shows that there is no separate carriage or horse-gear frame, but that the horse-gear is fixed beneath the frame that carries the trough, and that this frame can be raised or lowered on racks fixed on the inner sides of four shafts that rise vertically above the carriage-wheels. The frame is raised by the handle that projects from the front of the elevator, which moves a long shaft on each side of the frame; these shafts carry worms which gear into wheels and work the rack and pinions. The handle that in the illustration (Fig. 10) appears above and between the fore-wheels raises the trough by means of the hemp-rope and pulley-block. To hold the trough open the upper ends of the suspending ropes are fixed to the trough a little above the joint; to fold it up the ropes are attached near the upper extremity of the trough. A leather belt connects the horse-gear with a pulley on the driving-shaft of the ladder; this is objectionable. The trough of this machine is not framed, and is very light; it would be better if it were trussed with iron.

Fig. 10.—*Messrs. Barford and Perkins's Stacking-Machine, No.* 165.



No. 1455. *Beverley Iron Works Company.* This is of the same pattern, but differs from the machine last described in being more substantially constructed. The workmanship and materials are very good, but the trough is far too heavy. It was very hard work for two men to raise the frame with the slow motion, and it will be seen that 47 minutes were consumed by them in setting the machine for work. It is fair to note that a part of this was due to the coat of paint that covered the screws and impeded their working.

A short trial was given to the two forms of pitchforks worked by horse-power. The implement exhibited by Mr. H. Yorath was precisely the same as the one exhibited by the same maker last year at Cardiff, and described in the report of those trials. Mr. W. T. Wright entered three implements for trial, the only difference being that last year the double fork had three teeth on each side, while this year two other forks were brought for trial, one with two, and the other with one tooth on each side. A load of hay was transferred from one waggon to another by each exhibitor in the same time, viz. 11 minutes. The horse-power required to do this was not tested, but it is unquestionably less than was needed by any of the machine elevators doing similar work. These implements were not adapted to be worked by steam-power, and should not, therefore, have been entered for competition in a class for Combined Stacking-Machines. The quality of their work in stacking hay is decidedly inferior to that of the machine elevators. They take the hay off the waggon in large and somewhat unwieldy lumps; hay that has been stacked in this form will not come out nearly so well in the truss as that which has been delivered on to the rick in a thin even stream from a good machine elevator. The unloading of green hay from the waggon by one of the machine elevators is equal to giving it an extra tedding in the field. Another objection to the small implement is that it is not wholly under the control of one man. Neither man nor implement can well serve two masters. The evil results of this divided mastership may cause serious accidents in the use of Yorath's large pitchfork. The horse raises the fork by a rope from the whippletree that passes over two pulleys, and is attached to a link passing through the base of the wooden handle of the fork. The man on the waggon holds a guide rope attached to the top of the handle, swings the fork over the rick, and unloads it by slackening the rope suddenly. It will be seen that the man or boy leading the horse regulates the height to which the fork is raised, while the man on the waggon regulates its swing and the lowering of its long sharp points; two careful men, well used to work together, may work the fork successfully, but when worked by ordinary farm-labourers, the men upon the rick would apparently be exposed to an amount of risk that no economy in the cost of labour could justify.

The points of merit recorded in Table I. were awarded for the performance of each machine in the first three trials with hay, straw, and sheaf-corn. On summing up the totals we found three machines had obtained more than 600 marks out of a possible total of 750.

4841.	Tasker and Sons obtained	.. ..	715 points.
5588.	Wallis and Steevens ,,	.. ..	695 ,,
1234.	James Coultas ,,	.. ..	625 ,,

These three machines were, therefore, chosen for the final competition for the prize. It was already obvious that none of the other machines could be successful; but as all three machines were provided with independent horse-works, it was thought best to submit to the mechanical tests two of the self-contained machines that exhibited the best arrangement of horse-works below the trough; and for this purpose we selected

4391.	Holmes and Sons with	.. ..	575 points
165.	Barford and Perkins ,,	.. ..	495 ,,

Each of the five machines thus selected was then set to deliver a weighed quantity of 20 cwt. of wheatsheaves, each sheaf weighing about 11 lbs., over the rick-cloth, fixed 20 feet high; and the results of this run are recorded in columns 3 to 12 of Table II. It may be noticed that the circumference given here in column 5 is much less than that given in column 15 of Table I.; in Table I. the circumference is given of the circle described by the point of attachment on the shaft of the horse-works; in Table II. the middle of the horse-track is taken. Column 6 records the average draught indicated on a spring dynamometer interposed between the whippletree and the shaft of the horse-works. The work done by the horse is of course made up of the direct pull exerted by him multiplied by the distance through which he moves during the experiment; hence the foot-pounds of work recorded in column 7 are obtained by reducing the hundredweights in column 6 into pounds, and then multiplying by the circumference of the circle in column 5, and the number of circles described in column 4. Many makers of elevators state that their machines can be easily worked by a pony; it is quite clear, however, from column 7, that none of the machines in this trial could have been driven at the speed adopted by the exhibitors by any horse below the average in strength. The one that was employed throughout the trials was a quick stepping, powerful mare, that worked very willingly; but with most of the machines the work was done as a spurt for three or four minutes, with an effort that could not be sustained throughout a day's work. The slowest work was done by Wallis and Steevens's machine; but even in this case we find that, dividing the figures in column 7 by the four minutes, the power required slightly exceeds the 33,000 foot-pounds that Watt estimated a horse could perform per minute. While in the case of Coultas's machine 47,300 foot-pounds of work was done per minute, nearly half as much again as the theoretical horse-power, although that power is itself in excess of the average performance of farm horses. Columns 8, 9, 10, and 11 need no comment.

The ratios given in column 12 show that the greater part of the force expended by the horse serves simply to move the machine, and from 6 to 7 parts out of 10 are thus expended. The average efficiency of the three machines with independent horse-works is ·35, while that of the two self-contained machines, last on the list, is ·34. It would not, however, be safe to conclude at once that there is no mechanical advantage in placing the horse-gear immediately below the trough. Although when the horse-gear and elevator are thus tested as one whole machine, the advantage appears slightly to incline towards those that have horse-gears separate, we have yet to see whether this may not be solely due to superior mechanical construction in the ladder-chains and chain-wheels.

An examination of columns 13 to 18 will show that this is really the case. In this fifth trial the machines were tested apart from their horse-works; and in column 18 we find the average efficiency of the three machines first on the list is ·53, while that of the other two machines is only ·48. From this we may conclude that, so far as the horse-works alone are concerned, the self-contained machines have slightly the advantage, but that this is more than counterbalanced by the greater advantage which the other three machines possess in the construction of the parts of the elevator itself. Column 19 gives the average of columns 12 and 18, and determines the points of merit in column 21.

A sixth and final trial was made before points were awarded in column 22.

In threshing out corn in a well-filled rickyard, it is often of great importance that the elevator should be capable of removing straw at any angle from the threshing machine, so that the straw-rick may be built wherever there is room for it. This sixth trial was made so late in the week that we could not obtain from the show-yard the loan of the engine and threshing machine first selected. But at a very short notice we obtained an engine from Messrs. Aveling and Porter (lent with that alacrity and courtesy for which the Stewards and Judges of the Society have often had occasion to thank them), and an excellent threshing machine from the Beverley Iron and Waggon Company. Although the number on this machine showed that it was only the second sent out from these works, it threshed the corn very efficiently, the only inconvenience being that it was not fitted with the guide pulleys that some elevators need for working at any angle. We were, however, able to try all the elevators with it except that entered by Mr. Coultas. We found the machines with round hoppers could take the straw at any angle with the utmost facility; we, consequently, awarded full marks to the untried Coultas' machine, as well as to the two others with rounded hoppers entered by Messrs. Tasker and Sons and Messrs. Barford and Perkins. The machine of Messrs. Holmes and Sons, although its hopper was square, took the straw perfectly at any angle; this advantage was gained by the use of the fan-shaped expanding board that has been noticed in the description of their elevator. Messrs. Wallis and Steevens' machine took the straw well in a straight line and at right angles, but could not deliver it in other directions. Column 24 contains the awards, which we had no difficulty in deciding; the performance of Messrs. Tasker and Sons' machine, that obtained the prize of 25*l.*, was throughout excellent, as the award of 900 marks out of a possible total of 950 proves; the performance of the two machines next on the list was also very good. The commendations bestowed upon the Nos. 4391 and 165 must be understood as referring to ingenuity and novelty of design quite as much as to their performance. If the latter point had been exclusively considered, the machine exhibited by Mr. S. Lewin and Messrs. Tasker's two-wheeled machine would probably have had equal claims to be so distinguished.

In concluding the report of this trial, I may remark that the circumstances under which it was conducted were very different from those connected with the trial of last year; the Judges were not obliged to hurry over any part of it for want of sufficient time for judging. At the same time, it was felt that the implements in this class are probably still in a state of transition. The type for an elevator should not yet be considered as fixed. Different machines possess different merits. By combining these, and by further invention, we may hope to obtain better machines than any yet made. Perhaps before another seven years have gone by, the Council may think it desirable to give another extra trial to these comparatively recent inventions, that have already done so much to meet one of the difficulties experienced on the farm from the increasing scarcity of hand labour.

The trials of the combined elevators occupied the whole of the week allotted to the judging of implements. The trials of Single-furrow Ploughs ended on Thursday evening. The award of medals for miscellaneous articles, not included in the quinquennial rotation, was therefore made after the plough trials were ended, by Messrs. J. Hicken, J. D. Ogilvie, and T. P. Outhwaite, who in this class took the places of those who had previously been appointed to judge the miscellaneous articles as well as the elevators.

Of the ten silver medals placed at their disposal, the Judges awarded seven to the following exhibitors :—

178. Barford and Perkins, Peterborough, for their Patent Hand-Lifting Gear for Traction Engines.

1242. James Coultas, Grantham, for his Potato Planter.

1704. George Cheavin, Boston, Lincolnshire, for his Patent Rapid Water Filter for Agricultural Purposes.

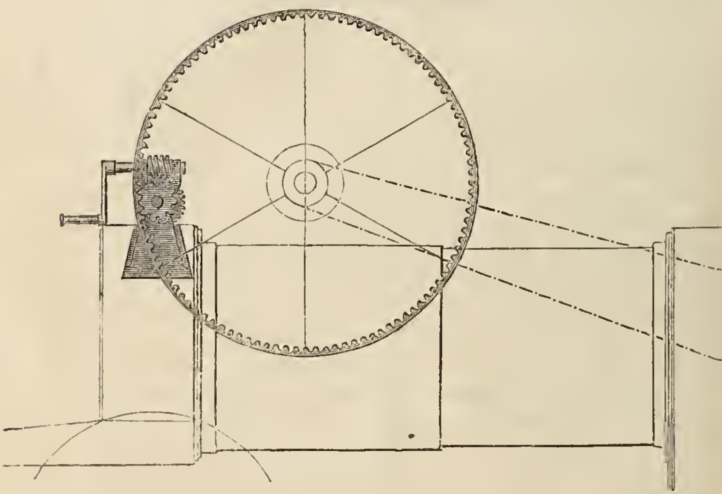
1975. Samuel Wilkerson, jun., Bassingbourn, Royston, for his Machine for Shooting Corn from one Sack to another.

4007. Kimball and Morton, of Glasgow and Dundee, for their Sack-Sewing Machine.

4788. Head, Wrightson, and Co., of Teesdale Ironworks, Stockton-on-Tees, for Moore's Patent Pulley Block.

5041. Davey, Paxman, and Co., of Standard Ironworks, Colchester, for their Apparatus for Heating Water in the Tank of Traction Engines by the Exhaust Steam.

Fig. 11.—*Messrs. Barford and Perkins's Patent Hand-lifting Gear for Traction Engines, No.* 178.

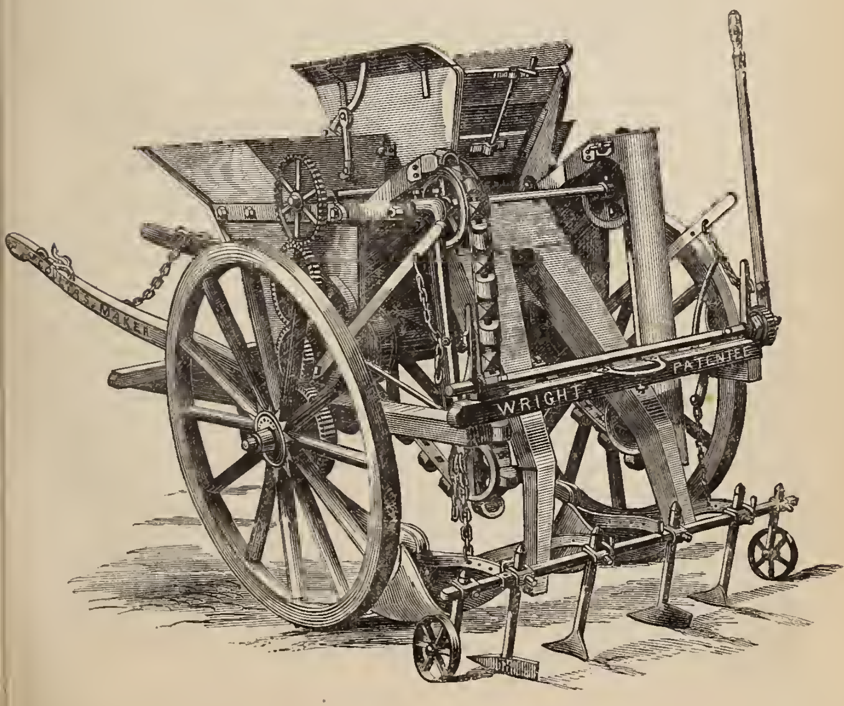


The first contrivance on this list is the invention of Mr. F. Savage, but exhibited by Messrs. Barford and Perkins; it is not intended for frequent use, but will be found of great service in starting an engine out of a hole or rut into which it may have sunk. When a misfortune of this kind occurs, much time is often lost in attempting to extricate the engine by steam-power alone. and danger is sometimes incurred by raising the steam pressure above the proper limit. By the contrivance exhibited in Fig. 11, the engine is provided with a powerful hand-purchase, by which it may be slowly moved by hand-power, acting either alone, or in conjunction with the steam-power. A crank-handle gives motion to a worm and worm-wheel; on the axis of the worm-wheel is a spur-pinion, gearing into teeth upon the inner periphery of the fly-wheel of the engine. The spur-pinion is strong enough to withstand the whole strain due to the steam pressure on the piston, that may be loaded inadvertently, or with the intention of assisting the hand-gear. By setting a man to turn the handle *against* the steam, the Judges found that he could easily overcome the full steam-power of the 10-horse engine, to which the apparatus was fitted.

It will be obvious that this very high power can only be obtained from manual labour at a very slow speed; but the hand-gear is only used for starting the engine, and may be thrown out by sliding the pinion along its axis directly the wheels are extricated from the hole. The apparatus will also be found serviceable in adjusting an engine to drive a threshing machine. The lifting gear can be fixed on any form of traction engine, at a cost of about 10*l.*

The Potato Planter (No. 1242) is manufactured and exhibited by Mr. James Coultas, under Wright's patent. Its general arrangements are similar to an ordinary turnip-drill, with the seed-box very much enlarged, and, in place of the ordinary seed-barrel, furnished with two revolving chains bearing wooden blocks, slightly cup-shaped at each end, each chain passing round

Fig. 12.—*Wright's Potato-planter, No.* 1242.



three chain-wheels. In their revolution the cups rise through the box filled with seed potatoes; the size of the cups being proportioned to the size of the seed, each cup takes up one potato; the cup is inverted as it enters the top of the metal tube shown on the right hand of Fig. 12. (The tube on the left side has been removed to show the shape of the cups.) The potato then falls upon the back of the next block, which is also slightly cupped to receive it. From the tube it falls into the furrow, that has been opened by the double-mouldboard plough fixed on the lower part of the frame. The small hopper at the top of the machine is furnished with one of Chambers's manure-barrels, and delivers the artificial manure down the wooden shoots into the two open furrows over the potatoes; the furrows are then closed by the action of the four covering breasts, and the land left flat. The small wheels at the side of the covering breasts regulate the depth of the furrows. The long handle to the right is used for raising the ploughs and breasts when turning on the headlands. This implement, invented in the autumn of last year, will be of great value to all large growers of potatoes, for it greatly simplifies and cheapens the operation of planting. The ridges are opened, the potatoes dropped at equal distances, artificial manure is distributed in any quantity, and the ridges are covered up in one single operation, without damaging the sets. The cost of the Two-row Planter, fitted with manure distributor, is 45*l.*

George Cheavin's Rapid Water Filter (No. 1704) is adapted for purifying pond or other water before it passes into the boiler of an engine. The boilers of traction and portable engines are very frequently corroded or furred up from the impurity of the water supplied to them. An ordinary filter is far too slow in its action to prepare water for such a purpose. This form of filter may be fitted on to the pipe of the engine-pump, and immersed in a tub or pond. All the water then drawn up by the engine will pass through a thickness of some three inches of animal charcoal. The filter is in a very compact form, with an iron case. A filter that does its work with great rapidity must of course become foul in a proportionately short time. A very ingenious arrangement for cleansing the filtering material without renewing the charcoal is introduced in this filter. The upper part of the centre of the filter is occupied by a perforated iron cylinder; the charcoal is packed round this cylinder, and between two perforated plates below it. To cleanse the filter a piston is fitted into the perforated cylinder, and by working this as a pump, air is forced through the charcoal until it is effectually cleansed. The two advantages of rapidity of action and facility for cleansing will make this filter of great value to the owners of engines used for thrashing and steam cultivation.

1975. *Samuel Wilkerson, jun. Sack Lifter and Shooter.* This contrivance enables one man to shoot corn rapidly and easily from one sack into another without assistance; it consists of a light fixed frame carrying two movable frames worked by a winch-handle and chain. The sack to be emptied is placed upon the elevator-board of a frame that rises vertically when the handle is turned, and the string of the sack is hung upon the lower blade of a knife fixed on the top of this frame. When the handle is turned the chain is wound up, and raises the frame with the sack upon it; two smaller self-acting chains are attached to the main chain and to certain levers; when the sack is raised to the full height (Fig. 13), one of these levers acts upon the knife and cuts the string of the sack, at the same moment a trigger upon the elevator-board striking the upper part of the fixed frame causes the sack to be pushed forward so that it falls upon a swing frame at the top of the machine in such a way that the mouth of the full sack is immediately opposite to the mouth of an empty sack that has previously been hung upon four hooks at the rear end of the swing-frame. The motion of the winch-handle is then reversed, and the lower end of the swing-frame is gradually raised till the whole contents have been shot from one sack into the other (Fig. 14); the freshly-filled sack is left standing upright upon the floor, and by touching a spring-handle the four hooks that held it open are simultaneously disen-

Figs. 13 and 14.—*Wilkerson's Sack-lifter and Shooter, No.* 1975.

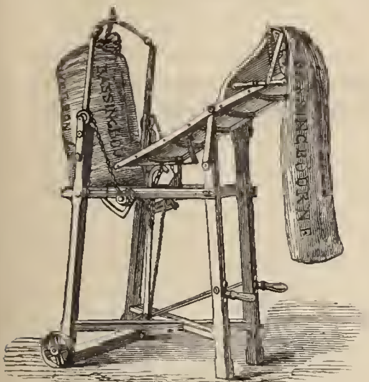


Fig. 13.—Showing sack lifted.

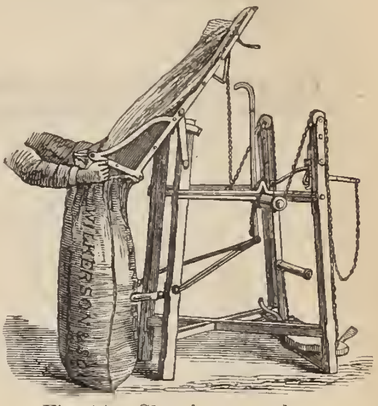


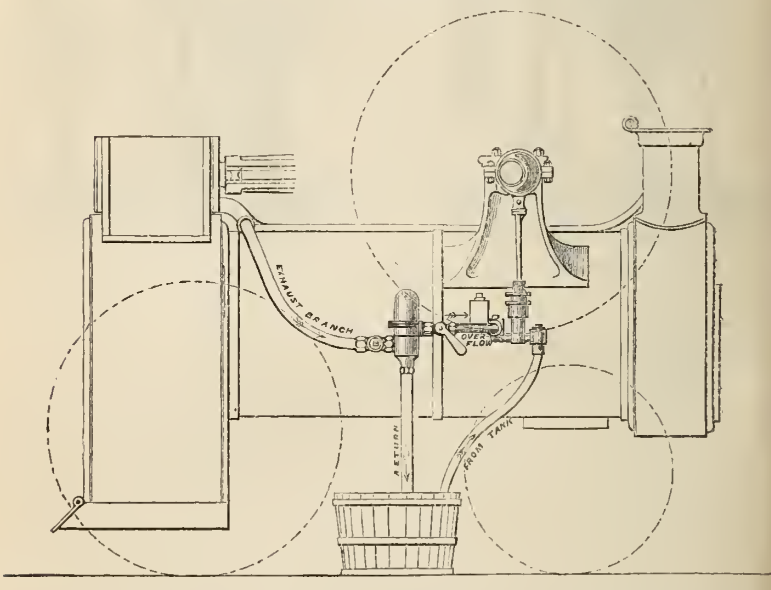
Fig. 14.—Showing corn shot.

gaged. The machine is easily worked by hand, and as it enables one man to do the work of three, it will be of great use to those who have occasion to transfer corn from sack to sack.

4007. *Kimball and Morton's Sack-Sewing Machine.* Since the first invention of sewing-machines they have year after year been adapted to fresh sorts of work; it is only recently that they have been able to work with the tarred jute or flax-thread that is used in sack-making. In using a very stout thread a large shuttle is required to carry it, and a very large loop must be made for this shuttle to pass through; the taking up of the slack from this loop has for a long time been a difficulty, but it is now overcome in a very ingenious manner by the use of a large cam acting upon a spring-arm guide. The ordinary sort of machine, sewing in a straight line, would not give sufficient elasticity to the stitch; special contrivances are therefore needed to produce a zigzag stitch, lapping round the edge of the sack. A stud on the rod of the frame is shunted from one groove to another upon a double-grooved cam; the needle-thread and the shuttle-thread meet, and are locked in the centre of the edge of the sack. The stitch thus made is firmer and more elastic than those made by hand. On cutting the thread, and then pulling the opposite sides of the sack, the Judges found that none of the stitches gave way. It is stated that a single machine will sew 1000 yards of sacking in 10 hours, and the double machines sew 2000 yards in the same time; where two sides of the sack are sewn the double machine should be used.

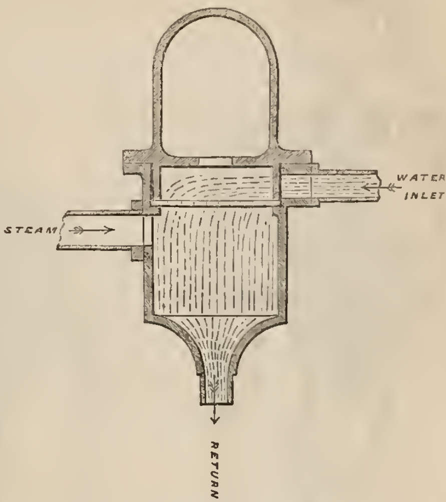
The stands of sewing-machines have lately been a marked feature in our show-yards; and, though always interesting to our fairer visitors, they have occasionally provoked criticism, as not being in any way agricultural. This is the first time that a silver medal has been awarded to such a machine, and it is well deserved by an invention that promises to prevent the scarcity of hand labour from increasing the price of farm sacks. We have not thought it necessary to illustrate the machine, as in its general arrangement it resembles other sewing machines. If any reader wishes for fuller information, he must let us yield *place aux dames*, and leave him to gain it more pleasantly from other sources.

Fig. 15.—*Messrs. Davey, Paxman, and Co.'s Apparatus for Heating Water in Tank of Traction Engine by the Exhaust-Steam, No.* 5041.



5041. *Davey, Paxman, and Co. Apparatus for heating Water in Tank of Traction Engines by Exhaust Steam.* The position of this apparatus upon a traction engine is shown in Fig. 15, where the first point to be noticed is its compactness and the facility with which it can be fitted to any engine. The two waste quantities of water from the overflow of the pump and steam from the exhaust are here admirably utilised to secure a constant supply of hot water for the supply of the boiler; thus saving fuel and lessening the wear and tear of the boiler, not only by preventing mechanical injury from the injection of cold water, but often also by lessening the chances of incrustation. Water that contains mineral impurities in solution will, when heated, deposit a portion of these impurities in the tank before it is required for use in the boiler. Fig. 16 is a section of the heater, and consists of three chambers,—the upper one filled with compressed air, the middle one with water, and the lowest with mixed steam and spray. The pipe on the left admits steam to the lowest chamber; the pipe on the right carries water from the overflow of the pump into the middle chamber. A brass disc, perforated by very small holes, separates these two chambers. The water is forced through these perforations by the action of the pump in the form of fine spray, which, mingling with the steam, is made hot and flows into the water-tank at nearly boiling point. The compressed air in the upper chamber makes the flow of the water through the perforations constant, and not intermittent, with the stroke of the pump. It is similar in its action to the air-chambers used in hydraulic rams, but requires no sniffle-valve, as fresh air is admitted every time the engine ceases to work. The Judges considered this a contrivance of great value, combining simplicity, lightness, and strength with a cheapness that brings it within the reach of all users of steam power. Its cost is 5*l.* 10*s.*, and, with slight modifications, it can be easily fitted to any engine or boiler.

Fig. 16.—*Section of Messrs. Davey, Paxman, and Co.'s Water-heating Apparatus, No.* 5041.



4788. *Head, Wrightson, and Co.*—This pulley-block or hoist is constructed on a novel and ingenious principle. Although its parts are simple in construction, and therefore not liable to get out of order, yet at first sight its action seems like a mechanical puzzle, and a full description of the illustrations given may perhaps be needed to explain the principles of its action. Two revolving discs (A and B, Fig. 17) are mounted face to face upon a shaft (C). The meeting face of each disc is dished out, and the periphery of each dished recess is formed into an internal toothed wheel (Fig. 19, p. 640). One disc has a tooth less in number than the other, but both have the same pitch diameter.

When the discs are mounted on the shaft C, the space formed by the meeting of these two recesses is occupied by the pinion D, of smaller pitch diameter than the internal disc wheels, A and B. This pinion is mounted *loose* upon an eccentric forged in one with the shaft C, passing through the discs, and is carried round by the revolution of the shaft and eccentric. In revolving, the pinion rolls round the periphery of the internal wheels, and in one complete orbit the faces of the two discs move a distance equal to the pitch of one of the disc teeth, owing to the gradual displacement of the odd tooth.

A chain-wheel (F and G) is cast on the back of each disc, and from the cross head and hook (H), to which the weight to be lifted is attached, two chains pass, one to the right side and one to the left side of either disc chain-wheel.

The loose ends pass over aud are connected at a convenient distance below the block, forming a loop (K), which falls as the weight is raised, and *vice versâ.*

The eccentric shaft is made to revolve by the spocket-wheel (L) keyed to

Figs. 17-19.—*Illustrations of Messrs. Head, Wrightson and Co.'s Pulley Block*, No. 4788.

Fig. 17.

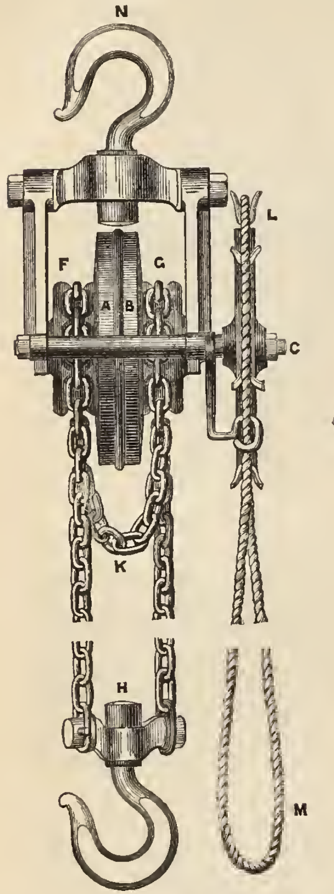


Fig. 18.

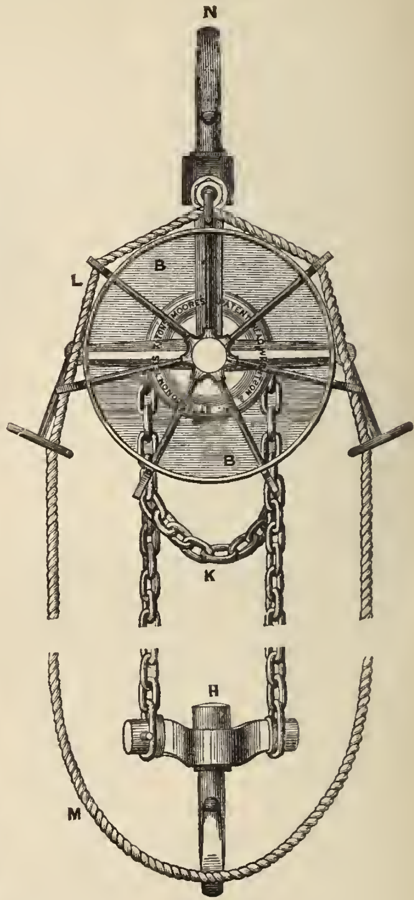
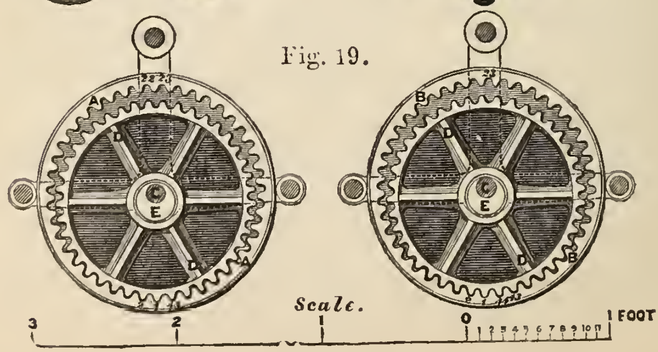


Fig. 19.



it, the wheel being worked by an endless hand-rope (M), and the machine is supported in a suitable frame with a suspending hook (N) at the top, to attach to a beam or other support.

Readers conversant with mechanics will excuse our pointing out to others that the pinion D, being *loose* upon the eccentric, does not act as an ordinary driving-wheel, but its teeth merely act as wedges, bringing the space between the teeth of one of the dished wheels exactly opposite a corresponding space in the other wheel. Thus, in Fig. 19 the only spaces that exactly correspond are those numbered 1 on each wheel: space 23, on wheel B is now opposite, not to space 23 on wheel A, but to the tooth between spaces 22 and 23 on A.

Half a revolution of D will gradually wedge the teeth apart till 23 is opposite the other 23; when the revolution of D is complete, space 44 on B will be opposite 1 on A.

The differential power is thus obtained by the gradual displacement of the odd tooth in the revolution of the pinion. The discs are perfectly free to move either way round in the frame, but the weight on H coming half on the right side and half on the left perfectly balances the block and keeps the lifting-chains plumb and fair under its centre. One revolution of the spocket-wheel (L) and the pinion (D) will thus cause the disc-wheel (A) to turn over from left to right $\frac{11}{16}$ths of an inch, and the disc-wheel (B) will revolve over in the opposite direction from right to left an equal distance; the sum of these distances equals ($1\frac{3}{8}$ inches) the pitch of the teeth on the disc-wheels. The diameter of the chain-wheels (F and G) is only half that of the disc-wheels (A and B), hence the hook (H) will only rise ·34 inch for each revolution of the spocket-wheel (L), and to obtain this small rise the hand-rope must be moved a space of 6 feet 3 inches. The pulley exhibited is intended to enable two men to raise a weight of $7\frac{1}{2}$ tons; from the above calculation they would have to pull the hand-rope 221 feet to raise the $7\frac{1}{2}$ tons 1 foot. The theoretical force required would be a pull of 76 lbs. plus the force needed to overcome friction. The actual force required was not ascertained by direct experiment, but friction would probably cause the total force to be very little, if at all, under 112 lbs., and two men of average strength might in that case raise the weight some 6 feet per hour.

A second hook could be attached at K, so that a fresh load might be raised by reversing the pull of the hand-rope without first lowering the chain. One advantage of this system is that the wedge-action of the pinion-teeth prevents the weight from running down when left half-raised.

The prices, of course, vary for blocks of different power; that of the $7\frac{1}{2}$ ton block is 12*l*. 10*s*., and the chain costs 5*s*. per foot, including the hook (H).

Royal Agricultural Society of England.

1873.

President.

EARL CATHCART.

Trustees.

Year when Elected.

1857 BRIDPORT, Viscount, *Cumberland Lodge, Windsor, Berkshire.*
1850 CHESHAM, Lord, *Latimer, Chesham, Bucks.*
1861 HOLLAND, EDWARD, *Dumbleton Hall, Evesham, Gloucestershire.*
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1860 MARLBOROUGH, Duke of, K.G., *Blenheim Park, Oxford.*
1846 MILWARD, RICHARD, *Thurgarton Priory, Southwell, Notts.*
1839 PORTMAN, Lord, *Bryanston, Blandford, Dorset.*
1856 POWIS, Earl of, *Powis Castle, Welshpool, Montgomeryshire.*
1858 RUTLAND, Duke of, K.G., *Belvoir Castle, Grantham, Leicestershire.*
1839 THOMPSON, HARRY STEPHEN, *Kirby Hall, York.*
1839 TREDEGAR, Lord, *Tredegar Park, Newport, Monmouthshire.*

Vice-Presidents.

1861 CATHCART, Earl, *Thornton-le-Street, Thirsk, Yorkshire.*
1839 CHICHESTER, Earl of, *Stanmer Park, Lewes, Sussex.*
1867 DEVONSHIRE, Duke of, K.G., *Holker Hall, Lancashire.*
1847 EGMONT, Earl of, *Cowdray Park, Petworth, Sussex.*
1847 EVERSLEY, Viscount, *Heckfield Place, Winchfield, Hants.*
1848 GIBBS, B. T. BRANDRETH, *Halfmoon Street, Piccadilly, London,* W.
1847 HILL, Viscount, *Hawkstone Park, Salop.*
1858 KERRISON, Sir EDWARD C., Bart., *Brome Hall, Scole, Suffolk.*
1839 MILES, Sir WILLIAM, Bart., *Leigh Court, Bristol, Somersetshire.*
1852 RICHMOND, Duke of, K.G., *Goodwood, Chichester, Sussex.*
1859 VERNON, Lord, *Sudbury Hall, Derby.*
1855 WYNN, Sir WATKIN WILLIAMS, Bt., M.P., *Wynnstay, Ruabon, Denbighshire.*

Other Members of Council.

1855 *ACLAND, Sir THOMAS DYKE, Bart., M.P., *Sprydoncote, Exeter, Devonshire.*
1858 AMOS, CHARLES EDWARDS, 5, *Cedars Road, Clapham Common, Surrey.*
1867 *BALDWIN, JOHN, *Luddington, Stratford-on-Avon, Warwickshire.*
1848 *BARNETT, CHARLES, *Stratton Park, Biggleswade, Bedfordshire.*
1853 BARTHROPP, NATHANIEL GEORGE, *Hacheston, Wickham Market, Suffolk.*
1868 BOOTH, THOMAS CHRISTOPHER, *Warlaby, Northallerton, Yorkshire.*
1863 BOWLY, EDWARD, *Siddington House, Cirencester, Gloucestershire.*
1861 *CANTRELL, CHARLES S., *Riding Court, Datchet, Bucks.*
1872 CHAPLIN, HENRY, M.P., *Blankney Hall, Lincoln.*
1866 DAVIES, DAVID REYNOLDS, *Agden Hall, Lymm, Cheshire.*
1861 *DENT, J. D., M.P., *Ribston Hall, Wetherby, Yorkshire.*
1860 DRUCE, JOSEPH, *Eynsham, Oxford.*

* Those Members of Council whose names are prefixed by an asterisk retire in July, but are eligible for re-election in May next.

Year when Elected.	
1868	EDMONDS, WILLIAM JOHN, *Southrope, Lechlade, Gloucestershire.*
1871	EGERTON, Hon. WILBRAHAM, M.P., *Rostherne Manor, Knutsford, Cheshire.*
1872	EXETER, Marquis of, K.G., *Burghley House, Stamford, Lincolnshire.*
1866	HORNSBY, RICHARD, *Spittle Gate, Grantham, Lincolnshire.*
1854	HOSKYNS, CHANDOS WREN, M.P., *Harewood, Ross, Herefordshire.*
1871	*JONES, J. BOWEN, *Ensdon House, Shrewsbury, Salop.*
1867	KESTEVEN, Lord, *Caswick, Stamford, Lincolnshire.*
1863	*KINGSCOTE, Colonel, M.P., *Kingscote, Wootton-under-Edge, Gloucestershire.*
1848	LAWES, JOHN BENNET, *Rothamsted, St. Albans, Herts.*
1869	*LEEDS, ROBERT, *Wicken Farm, Castleacre, Brandon, Norfolk.*
1872	LEICESTER, Earl of, *Holkham Hall, Wells, Norfolk.*
1868	LICHFIELD, Earl of, *Shugborough, Staffordshire.*
1867	*LIDDELL, Hon. HENRY GEORGE, M.P., *Ravensworth Castle, Durham.*
1865	*LOPES, Sir MASSEY, Bart., M.P., *Maristow, Roborough, Devon.*
1871	*McINTOSH, DAVID, *Havering Park, Romford, Essex.*
1871	MASFEN, R. HANBURY, *Pendeford, Wolverhampton, Staffordshire.*
1857	*PAIN, THOMAS, *The Grove, Basingstoke, Hants.*
1861	RANDELL, CHARLES, *Chadbury, Evesham, Worcestershire.*
1868	*RANSOME, ROBERT CHARLES, *Ipswich, Suffolk.*
1871	RAWLENCE JAMES, *Bulbridge, Wilton, Salisbury, Wilts.*
1869	*RIDLEY, M. WHITE, M.P., *Blagdon, Cramlington, Northumberland.*
1861	*RIGDEN, WILLIAM, *Hove, Brighton, Sussex.*
1861	SANDAY, WILLIAM, *Radcliffe-on-Trent, Notts.*
1856	SHUTTLEWORTH, JOSEPH, *Hartsholme Hall, Lincoln.*
1872	*SKELMERSDALE, Lord, *Lathom Hall, Ormskirk, Lancashire.*
1869	STATTER, THOMAS, *Stand Hill, Whitefield, Manchester, Lancashire.*
1867	*STONE, N. CHAMBERLAIN, *Aylestone Hall, Leicester.*
1857	*TORR, WILLIAM, *Aylesby Manor, Great Grimsby, Lincolnshire.*
1845	*TURNER, GEORGE, *Brampford Speke, Exeter, Devonshire.*
1871	*TURNER, JABEZ, *Haddon, Huntingdonshire.*
1871	*WAKEFIELD, WILLIAM H., *Kendal, Westmoreland.*
1867	*WEBB, JAMES, *Spring Hill, Fladbury, Pershore, Worcestershire.*
1870	WELBY, WILLIAM EARLE, M.P., *Newton House, Folkingham, Lincolnshire.*
1871	*WELLS, JOHN, *Booth Ferry, Howden, Yorkshire.*
1861	WELLS, WILLIAM, M.P., *Holmewood, Peterborough, Northamptonshire.*
1870	WHITEHEAD, CHARLES, *Barming House, Maidstone, Kent.*
1866	*WILSON, Lieut.-Colonel FULLER MAITLAND, *Stowlangtoft Hall, Bury St. Edmund's, Suffolk.*
1865	*WILSON, JACOB, *Woodhorn Manor, Morpeth, Northumberland.*

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H. M. JENKINS, 12, *Hanover Square, London*, W.

Consulting Chemist—Dr. AUGUSTUS VOELCKER, F.R.S., 11, *Salisbury Square*, E.C.
Consulting Botanist—W. CARRUTHERS, F.R.S., F.L.S., *British Museum*, W.C.
Consulting Veterinary Surgeon—JAMES BEART SIMONDS, *Royal Veterinary College*, N.W.
Consulting Engineers—EASTONS & ANDERSON, *The Grove, Southwark Street*, S.E.
Seedsmen—THOMAS GIBBS and Co., *Corner of Halfmoon Street, Piccadilly*, W.
Publisher—JOHN MURRAY, 50, *Albemarle Street*, W.
Bankers—THE LONDON AND WESTMINSTER BANK, *St. James's Square Branch*, S.W.

* Those Members of Council whose names are prefixed by an asterisk retire in July, but are eligible for re-election in May next.

STANDING COMMITTEES FOR 1873.

Finance Committee.

Bridport, Viscount, Chairman.
Davies, D. R.
Kingscote, Colonel, M.P.
Randell, Charles.
Torr, William.

House Committee.

The President.
Chairman of Finance Committee.
Davies, D. R.
Kingscote, Colonel, M.P.
Gibbs, B. T. Brandreth.
Torr, William.

Journal Committee.

Thompson, H. S., Chairman.
Cathcart, Earl.
Vernon, Lord.
Acland, Sir T. Dyke, Bart., M.P.
Dent, J. D., M.P.
Holland, Edward.
Hoskyns, C. Wren, M.P.
Kingscote, Colonel, M.P.
Milward, Richard.
Ridley, M. White, M.P.
Welby, W. E., M.P.
Wells, W., M.P.
Whitehead, Charles.
Wilson, Jacob.

Chemical Committee.

Wells, William, M.P., Chairman.
Leicester, Lord.
Lichfield, Lord.
Vernon, Lord.
Chaplin, H., M.P.
Davies, D. R.
Dent, J. D., M.P.
Edmonds, W. J.
Hoskyns, C. Wren, M.P.
Lawes, J. B.
Voelcker, Dr. A.
Wakefield, W. H.
Welby, W. E., M.P.
Whitehead, Charles.
Wilson, Colonel.
Wilson, Jacob.

Botanical Committee.

Vernon, Lord.
Dent, J. D., M.P.
Edmonds, W. J.
Gibbs, B. T. Brandreth.
Jones, J. Bowen.
Thompson, H. S.
Turner, Jabez.
Voelcker, Dr.
Welby, W. E., M.P.
Wells, W., M.P.
Whitehead, Charles.

Veterinary Committee.

Exeter, Marquis of.
Bridport, Viscount.
Booth, T. C.
Brown, Professor.
Dent, J. D., M.P.
Egerton, Hon. Wilbraham, M.P.
Gibbs, B. T. Brandreth.
Leeds, Robert.
Masfen, R. H.
Ridley, M. White, M.P.
Simonds, Professor.
Statter, Thomas.
Thompson, H. S.
Wells, William, M.P.
Wilson, Jacob.

Stock-Prizes Committee.

Bridport, Viscount.
Barthropp, Nathaniel G.
Booth, T. C.
Bowly, Edward.
Davies, D. R.
Dent, J. D., M.P.
Druce, Joseph.
Gibbs, B. T. Brandreth.
Leeds, Robert.
Masfen, R. H.
Milward, Richard.
Randell, Chas.
Ridley, M. White, M.P.
Rigden, Wm.
Sanday, Wm.
Torr, William.
Turner, George.
Wakefield, W. H.
Wells, John.
Wilson, Jacob.
The Stewards of Live Stock.

Implement Committee.

Booth, T. C., Chairman.
Bridport, Viscount.
Vernon, Lord.
Amos, C. E.
Cantrell, Chas. S.
Druce, Joseph.
Edmonds, W. J.
Gibbs, B. T. Brandreth.
Hornsby, Richard.
Hoskyns, C. Wren, M.P.
Jones, J. Bowen.
Leeds, Robert.
Masfen, R. H.
Randell, Charles.
Ransome, R. C.
Sanday, William.
Shuttleworth, Joseph.
Thompson, H. S.
Torr, William.
Wakefield, W. H.
Welby, W. Earle, M.P.
Wells, John.
Whitehead, Charles.
Wilson, Jacob.
The Stewards of Implements.

General Hull Committee.

Wynn, Sir Watkin W., Bart., M.P. (Chairman).
Lichfield, Earl of.
Powis, Earl of.
Bridport, Viscount.
Chesham, Lord.
Kesteven, Lord.
Tredegar, Lord.
Vernon, Lord.
Lopes, Sir Massey, Bart., M.P.
Macdonald, Sir A. K., Bart.
Bannister, A.
Barnett, C.
Beverley, Mayor of.
Booth, T. C.
Bowly, Edward.
Cantrell, Charles S.
Davies, D. R.
Dent, J. D., M.P.
Druce, Joseph.
Edmonds, W. J.
Gibbs, B. T. Brandreth.
Hornsby, Richard.
Hoskyns, C. Wren, M.P.
Hull, Mayor of.
Kingscote, Col., M.P.
Leeds, Robert.
Milward, Richard.
Randell, Charles.
Ransome, R. C.
Ridley, M. W., M.P.
Roberts, G. C.
Shuttleworth, Joseph.
Tiffen, J.
Torr, William.
Webb, James.
Wells, John.
Wells, William, M.P.
Whitehead, Charles.
Wilson, Jacob.
The Stewards.

Show-Yard Contracts Committee.

Randell, Charles, Chairman.
Bridport, Viscount.
Vernon, Lord.
Amos, C. E.
Booth, T. C.
Gibbs, B. T. Brandreth.
Hornsby, Richard.
Milward, Richard.
Shuttleworth, Joseph.
Torr, William.
Wells, John.
Wilson, Jacob.

Committee of Selection.

Bridport, Viscount.
Davies, D. R.
Dent, J. D., M.P.
Gibbs, B. T. Brandreth.
Holland, E.
Kingscote, Colonel, M.P.
Milward, R.
Randell, Charles.
Thompson, H. S.
Torr, William.
Wells, William, M.P

And the Chairmen of the Standing Committees.

Education Committee.

Holland, E., Chairman.
Lichfield, Earl of.
Powis, Earl of.
Acland, Sir T. Dyke, Bart., M.P.
Dent, J. D., M.P.
Jones, J. Bowen.
Kingscote, Colonel, M.P.
Ransome, R. C.
Wells, William, M.P.
Voelcker, Dr.
Whitehead, Charles.

Cattle Plague Committee.

The whole Council.

*** The President, Trustees, and Vice-Presidents are Members *ex officio* of all Committees.

Royal Agricultural Society of England.

GENERAL MEETING,

12, Hanover Square, Thursday, December 12, 1872.

REPORT OF THE COUNCIL.

The Council of the Royal Agricultural Society are gratified at being able to preface the usual Report of their proceedings since the last General Meeting, by stating that the past year has witnessed a considerable accession to the list of Members.

During the past half-year 8 Governors and 68 Members have died, and the names of 18 Members have been removed from the list by order of the Council; but, on the other hand, 11 Governors and 269 Members have been elected, so that the Society now consists of

77 Life Governors,
63 Annual Governors,
1687 Life Members,
4104 Annual Members,
14 Honorary Members,

making a total of 5945, and, when coupled with the changes reported at the half-yearly meeting in May, showing an increase of 138 Members during the year 1872.

The Council desire to bear testimony to the great loss that they have sustained by the death of their veteran colleague, Colonel Challoner; and they have to report that Mr. Milward, of Thurgarton Priory, Notts, has been elected to fill the consequent vacancy in the list of Trustees. The vacancy in the Council resulting from Mr. Milward's election has been filled up by the election of Lord Skelmersdale.

The half-yearly statement of accounts to the 30th of June, 1872, has been examined and approved by the Society's auditors and accountants, and has been published for the information of the Members in the last number of the 'Journal.' The permanent funded capital of the Society remains the same as at the last half-yearly meeting, namely, 24,112*l.* 7*s.* 8*d.*, and the balance in the hands of the bankers on the 1st instant was 618*l.* 16*s.* 10*d.* These figures are sufficient to show that the financial position of the Society continues to be satisfactory.

The Council have increased the salary of the Secretary by 100*l.* per annum in consideration of the efficient services he has rendered to the Society during the period he has held that office.

In the Report of the Council last December it was stated that a Special Committee had been appointed to consider the whole question of the receipts and expenditure of the Society, especially at the Country-meetings, and the possibility of securing equal results at less cost. After a most exhaustive enquiry the Committee made a series of recommendations, which, it is hoped, may exclude from the Show-yard a large number of articles not connected with agriculture, and thus attain the double object of curtailing the expenditure of the Society, and reducing the area of the exhibition without diminishing its usefulness.

Cathays Park, liberally placed by the Marquess of Bute at the disposal of the Society for the Cardiff Meeting, formed a most commodious and picturesque Show-ground, possessing the additional advantages of being well drained and walled in, and in every way adapted to the requirements of the Society. No exertions were spared by the Mayor of Cardiff (Mr. E. David), Lord Bute's agent (Mr. J. S. Corbett), and the Local Committee to ensure the success of the Meeting at one of the most distant spots which the Society has yet visited. The Council are, therefore, gratified in stating that the results of the Meeting at Cardiff have, in their opinion, justified their choice of that locality for the Society's Exhibition, more particularly in reference to its future effect on the agriculture of the adjacent districts.

The trials of Portable Steam Engines, Threshing Machines, Straw Elevators, &c., with which the Cardiff Meeting commenced, were carried out by the Stewards, Judges, and Engineers, with the utmost care and patience, during a week of rain and storms. An illustrated report on the trials of all the Implements, except Portable Steam Engines, carefully prepared by Mr. C. G. Roberts, of Haslemere, Surrey, has been published in the last number of the 'Journal,' and will, doubtless, be found useful both by farmers and manufacturers. The report on the trials of Portable Steam Engines has been prepared by the Engineer Judges, and will be published in the next number of the 'Journal.'

The wet weather of the trial-week was fortunately succeeded by several days of sunshine, and the Cardiff meeting, therefore, approached nearer to a financial success than either of its immediate predecessors. As an exhibition of Stock it presented some distinctive features, which have been well portrayed by Mr. Henry Corbet, the Secretary of the Central Farmers' Club, in his Report published in the last number of the 'Journal.' As an exposition of the prevailing character of the Live Stock of the neighbourhood, it must be regarded as successful in consequence of the large number of local exhibitors; while the relatively small number of entries of Welsh cattle and sheep seem rather to indicate that the native races are being displaced by improved English breeds, than that their true importance was inadequately represented in the Show-yard.

The competition for the Prize Cup offered by Sir Watkin W. Wynn, Bart., the President of the Society at the Cardiff Meeting, for the best managed farm in South Wales and Monmouthshire, excited the keenest interest in the district, from the time of the publication of the list of competitors, up to the announcement of the awards of the Judges, at the General Meeting of Members held in the Show-yard. An able report on the Prize and Commended Farms, written by Mr. T. Bowstead, of Eden Hall, Penrith, one of the Judges, will, it is hoped, be carefully read by many farmers both in and outside the district, and thus produce beneficial results beyond the circle of those who were more immediately interested in the competition.

The Council regret that the competition for the prizes offered by the Marquess of Bute and Major Picton Turbervill, for plans of cottages for agricultural labourers to cost not more than 220*l.* per pair, and those for miners to cost not more than 90*l* each, failed to produce a satisfactory result. No plans were sent in which, in the opinion of the Judges, could be built for the stipulated sums, and also possessed sufficient merit to justify them in awarding a prize; but the ground plans of one pair of cottages (exhibited by Mr. Hine, of the Patent Brick Works, Worcester) were commended, and will be published in the next number of the 'Journal.'

The Implement Prize-Sheet for the ensuing Country Meeting, to be held at Hull, has been carefully arranged after consultation with some of the leading manufacturers. Prizes are offered for sixteen classes of Ploughs, six classes of Harrows, four of Rollers and Clodcrushers, four of Cultivators and Scarifiers, besides Digging Machines, Potato-ploughs, and Miscellaneous articles. The date of the meeting has been fixed for Monday, July 14th, and the four following days, and the Trials of Implements have been ordered to commence on Monday morning, July 7th.

The Council have decided to offer two prizes, of 100*l.* each, for the best managed farms in the Holderness and Wold districts of the East Riding of Yorkshire respectively. The last day of entry has been fixed for January 31st, and the conditions of competition will remain as on previous occasions.

The extensive damage to this year's Potato-crop, caused by the too familiar potato-disease, has prompted the President of the Society to offer a prize of 100*l.* for the best Essay on the potato-disease and its prevention. The Council have thankfully accepted Earl Cathcart's generous offer, and have decided that the competing essays shall be sent in on or before November 1st, 1873, subject to the usual conditions of the Society, as follows:—

All information contained in Prize Essays shall be founded on experience or observation, and not on simple reference to books or other writings.

Drawings, specimens, or models, drawn or constructed to a stated scale, shall accompany writings requiring them.

All competitors shall enclose their names and addresses in a cover, on which only their motto, and the subject of their Essay, shall be written.

The President or Chairman of the Council, for the time being, shall open the cover on which the motto designating the Essay to which the prize has been awarded is written, and shall declare the name of the author.

The Chairman of the Journal Committee shall alone be empowered to open the motto-paper of such Essays, not obtaining the prize, as he may think likely to be useful for the Society's objects, with a view of consulting the writer confidentially as to his willingness to place such paper at the disposal of the Journal Committee.

The copyright of all Essays gaining prizes shall belong to the Society, who shall accordingly have the power to publish the whole or any part of such Essays, and other Essays will be returned on the application of the writers ; but the Society do not make themselves responsible for their loss.

The Judges are not bound to award a prize unless they consider one of the Essays deserving of it.

In all reports of experiments the expenses shall be accurately detailed.

The imperial weights and measures only are those by which calculations are to be made.

No prize shall be given for an Essay which has been already in print.

Prizes may be taken in money or in plate, at the option of the successful candidate.

All Essays must be addressed to the Secretary, at the house of the Society.

Every Essay must be written in the English language, or must be accompanied by an English translation.

Since the last half-yearly meeting, the trial of "Kidd *v.* the Royal Agricultural Society" has taken place at Leeds. This action was brought by Mr. Kidd, in consequence of some statements made in the Quarterly Report of the Chemical Committee last March.

The trial was held before Mr. Justice Blackburn and a special jury, and lasted for three days. The jury deliberated for five hours, and ultimately gave a verdict of 10*l.* 10*s.* against the Society, which will carry costs. In order to give all members of the Society an opportnnity of expressing their opinion on the course pursued by the Council, a *verbatim* report of the proceedings was published in the last number of the Journal ; and the action that has since been taken by the seed-crushers in Hull leads the Council to believe that the trial, although unfortunate to the

Society in a pecuniary point of view, has been of considerable value to the agriculttural interest.

In connection with this trial, the Council gratefully acknowledge the sympathy which they have received from the Committees of several agricultural bodies. This movement, commenced by the Lincolnshire Agricultural Society, and accompanied by a vote of 100*l.*, has been followed by another vote of 100*l.*, from the Smithfield Club, a vote of 20*l.* from the Central Farmers' Club, and votes of thanks from the Central Chamber of Agriculture, the Manchester and Liverpool Agricultural Society, and the Norfolk and West Suffolk Chambers of Agriculture.

Under these circumstance the Council, profiting by the experience they have gained, and feeling the necessity of the utmost vigilance on the part of the Chemical Committee in the preparation of their Quarterly Reports, as well as having due regard to the law laid down by the judge in his summing up at the late trial, have decided to continue their publication.

The Education Grant has been renewed for the year 1873, on the general scheme which has now been continued for several years past; but in the hope of attracting a larger number of candidates, the restrictions as to the age of those eligible to compete for prizes have been removed, while the offer of special prizes for exceptional merit in particular subjects has been discontinued.

In consequence of a communication from Her Majesty's Commissioners for the Vienna International Exhibition, 1873, a Committee of the Council has been appointed to assist Her Majesty's Commissioners, and to aid in securing a due representation of British Agriculture at that important international meeting. Already arrangements have been made for an adequate area to be set apart for this purpose; and the Council are at present endeavouring to secure an efficient representative of England on the Jury for Agricultural Machinery, as well as arranging for a report on the Agricultural features of the whole exhibition.

During the past year the live stock of the farm has been unusually subject to diseases of an epizootic character. The prevalence of the foot-and-mouth disease last year induced the Council to "draw the attention of the Government to the existing regulations in reference to the importation of both foreign and Irish cattle, and to the restrictions which it is desirable to impose in order to diminish the risk of their conveying contagious or infectious diseases to English stock." Since then the increasing gravity of the circumstances induced the Council, last July, to send a deputation on the subject to the Vice-President of the Privy Council, and subsequently to the Lord Lieutenant of Ireland and the Chief Secretary.

The Council of the Society were requested by Mr. Forster to inform him specifically, in writing, what regulations they would recommend. The Council therefore commissioned the Secretary of the Society to make such an investigation into the facts and circumstances of the trade in animals as would assist them in complying with the request of the Government.

During the summer recess he has accordingly visited the ports of shipments of cattle in Ireland and the Continent, four times traversed the German Ocean, and seven times the Irish Channel in cattle steamers, and been present at several of the principal English markets and Irish fairs. A summary of the facts observed has been laid before the Council and formally communicated to the Government, together with suggestions of the Council for fresh regulations; and a paper giving an ample account of the Secretary's investigations is in preparation for the ensuing number of the 'Journal.'

In addition to the foot-and-mouth disease, the outbreak of cattle-plague in the East Riding of Yorkshire, has been a matter of grave anxiety to the Council. Fortunately the prompt and energetic action of the local authorities and the ready co-operation of most of the farmers in the districts, assisted by the advice of the Veterinary Department of the Privy Council, restricted the spread of the disease within a much narrower compass than at one time seemed probable. An investigation into the circumstances which preceded this outbreak, and some of which appear to have been its immediate cause, will be published in the next number of the 'Journal.'

Still more recently, an increase in the number of animals affected with pleuro-pneumonia has been noticeable in many parts of England; but it is satisfactory to observe that the Privy Council have issued an order which gives sufficient power to local authorities who desire to stamp out this disease. The

Council therefore strongly recommend the Members of the Soeiety to exert their influence in their several districts to induce the loeal authorities to use the power of compulsory slaughter which has reeently been vested in them by the Privy Council.

The Council are glad to report that they have received from the Governors of the Royal Veterinary College the announcement that a more satisfaetory supply of specimens of diseased animals has recently been furnished to the College by Members of the Society; and the Couneil take this opportunity of ealling special attention to the benefits likely to result from a still larger number of subjeets being forwarded to the College by rendering possible the more praetical education of students of the veterinary art.

By order of the Couneil,

H. M. JENKINS,

Seeretary.

MEMORANDA.

Address of Letters.—The Society's office being situated in the postal district designated by the letter W, members, in their correspondence with the Secretary, are requested to subjoin that letter to the usual address.

General Meeting in London, May 22, 1873, at 12 o'clock.

Meeting at Hull, July, 1873.

General Meeting in London, in December, 1873.

Monthly Council (for transaction of business), at 12 o'clock on the first Wednesday in every month, excepting January, September, and October: open only to Members of Council aud Governors of tbe Society.

Adjournments.—Tbe Council adjourn over Passion and Easter weeks, wben those weeks do not include tbe first Wednesday of the montb; from the first Wednesday in August to the first Wednesday in November; and from the first Wednesday in December to tbe first Wednesday in February.

Office Hours.—10 to 4. On Saturdays, from the Council Meeting in August nntil tbe Conncil Meeting in April, 10 to 2.

Diseases of Cattle, Sheep, and Pigs.—Members have the privilege of applying to the Veterinary Committee of tbe Society, and of sending animals to the Royal Veterinary College on the same terms as if they were subscribers to the College.—(A statement of tbese privileges will be found in the Appendix.)

Chemical Analysis.—The privileges of Chemical Analysis enjoyed by Members of the Society will be found stated in the Appendix to the present volume.

Botanical Privileges.—The Botanical Privileges enjoyed by Members of the Society will be found stated in the Appendix to the present volnme.

Subscriptions.—1. Annual.—The subscription of a Governor is £5, and that of a Member £1, due in advance on the 1st of January of each year, and becoming in arrear if unpaid by the 1st of June. 2. For Life.—Governors may compound for their subscription for future years by paying at once the sum of £50, and Members by paying £10. Governors and Members wbo have paid their annual subscription for 20 years or upwards, and whose subscriptions are not in arrear, may compound for future annual subscriptions, that of the current year inclusive, by a single paymeut of £25 for a Governor, and £5 for a Member.

Payments.—Subscriptions may be paid to the Secretary, in the most direct and satisfactory manner, either at the office of tbe Society, No. 12, Hanover Square, London, W., or by means of post-office orders, to be obtained at any of the principal post-offices throughout the kingdom, and made payable to him at the Vere Street Office, London, W.; but any cheque on a banker's or any other house of business in London will be equally available, if made payable on demand. In obtaining post-office orders care should be taken to give the postmaster tbe correct initials and surname of the Secretary of the Society (H. M. Jenkins), otherwise the payment will be refused to him at tbe post-office on which such order has been obtained; and when remitting the money-orders it should be stated by wbom, and on whose account, they are sent. Cheques should be made payable as drafts on demand (not as bills only payable after sight or a certain number of days after date), and should be drawn on a London (not on a local country) banker. When payment is made to the London and Westminster Bank, St. James's Square Branch, as the bankers of the Society, it will be desirable that tbe Secretary should be advised by letter of such payment, in order that the entry in the banker's book may be at once identified, and the amount posted to tbe credit of the proper party. No coin can be remitted by post, unless tbe letter be registered.

New Members.—Every candidate for admission into the Society must be proposed by a Member; the proposer to specify in writing the full name, usual place of residence, and post-town, of the candidate, either at a Council meeting, or by letter addressed to the Secretary. Forms of Proposal may be obtained on application to the Secretary.

*** Members may obtain on application to the Secretary copies of an Abstract of the Charter and Bye-laws, of a Statement of tbe General Objects, &c., of the Society, of Chemical, Botanical, and Veterinary Privileges, and of other printed papers connected with special departments of tbe Society's bnsiness.

Royal Agricultural Society of England.

1873.

DISTRIBUTION OF MEMBERS OF THE SOCIETY AND OF MEMBERS OF COUNCIL.

Districts.	Counties.	Number of Members.		Number in Council.		Members of Council.
A.	Durham	87		1		Hon. H. G. Liddell.
	Northumberland	135		2		M. White Ridley; Jacob Wilson.
	Yorkshire — North and East Ridings	135		3		Earl Cathcart, V.P.; T. C. Booth; John Wells.
			357		6	
B.	Bedfordshire	48		1		C. Barnett.
	Cambridgeshire	62				
	Essex	121		1		D. McIntosh.
	Hertfordshire	99		1		J. B. Lawes.
	Huntingdonshire	37		2		Jabez Turner; W. Wells.
	Norfolk	162		2		Earl of Leicester; Robert Leeds.
	Suffolk	157		3		Sir E. C. Kerrison, V.P.; N. G. Barthropp; Lieutenant-Colonel Wilson.
			686		10	
C.	Cornwall	42				
	Devonshire	100		3		Sir T. D. Acland; Sir M. Lopes; G. Turner.
	Dorsetshire	65		1		Lord Portman, T.
	Somersetshire	114		1		Sir W. Miles, V.P.
	Wiltshire	98		1		J. Rawlence.
			419		6	
D.	Derbyshire	75		1		Lord Vernon, V.P.
	Leicestershire	126		2		Duke of Rutland, T.; N. C. Stone.
	Lincolnshire	200		5		Marquis of Exeter; Henry Chaplin; Lord Kesteven; W. Torr; W. Earle Welby.
	Northamptonshire	96				
	Nottinghamshire	131		2		R. Milward, T.; W. Sanday.
	Rutlandshire	15				
	Warwickshire	155		1		J. Baldwin.
			798		11	

DISTRIBUTION OF MEMBERS OF THE SOCIETY—*continued.*

Districts.	Counties.	Number of Members.	Number in Council.	Members of Council.
E.	Cumberland	94 ..	—	
	Lancashire	222 ..	3	Duke of Devonshire, V.P.; Lord Skelmersdale; T. Statter.
	Westmoreland ..	53 ..	1	W. H. Wakefield
	Yorkshire — West Riding	126 ..	2	H. S. Thompson, T.; J. D. Dent.
		—— 495	— 6	
F.	Gloucestershire ..	188 ..	4	E. Bowly; W. J. Edmonds, E. Holland, T.; Col. Kingscote.
	Herefordshire ..	100 ..	1	C. Wren Hoskyns.
	Monmouthshire ..	64 ..	1	Lord Tredegar, T.
	Worcestershire ..	139 ..	2	C. Randell; James Webb.
	South Wales	148		
		—— 639	— 8	
G.	Berkshire	130 ..	1	Viscount Bridport, T.
	Buckinghamshire ..	62 ..	2	Lord Chesham, T.; C. S. Cantrell.
	Hampshire	136 ..	3	Viscount Eversley, V.P.; Sir A. K. Macdonald, T.; T. Pain.
	Kent	249 ..	1	C. Whitehead.
	Middlesex	273 ..	1	B. T. Brandreth Gibbs, V.P.
	Oxfordshire	146 ..	2	Duke of Marlborough, T.; J. Druce.
	Surrey	136 ..	1	C. E. Amos.
	Sussex	132 ..	4	Earl of Chichester, V.P.; Earl of Egmont, V.P.; Duke of Richmond, V.P.; W. Rigden.
		——1264	— 15	
H.	Cheshire...	150 ..	2	D. R. Davies; Hon. W. Egerton.
	Shropshire	306 ..	2	Viscount Hill, V.P.; J B. Jones.
	Staffordshire ..	258 ..	2	Earl of Lichfield; R. H. Masfen.
	North Wales ..	129 ..	2	Earl of Powis, T.; Sir W. Wynn. V.P.
		—— 843	— 8	
Scotland		68		
Ireland		82		
Channel Islands		12		
Isle of Man		2		
Foreign Countries		74		
Members without addresses ..		83		
		—— 321		

Implement Makers.

R. Hornsby.
R. C. Ransome.
J. Shuttleworth.

ROYAL AGRICULTURAL

Dr. **Half-yearly Cash Account**

		£. s. d.	£. s. d.
To Balance in hand, 1st July, 1872:—			
Bankers		1,799 1 0	
Secretary		21 15 7	
At Deposit with London and Westminster Bank		2,000 0 0	
			3,820 16 7
To Income:—			
Dividends on Stock		355 13 2	
Interest on Deposit Account		46 7 6	
Subscriptions:—	£. s. d.		
Governors' Life-Compositions	250 0 0		
Members' Life-Compositions	457 0 0		
Members' Annual	821 0 0		
		1,528 0 0	
Journal (one year):—			
Sales	171 6 8		
Advertisements	61 8 5		
		232 15 1	
Sundries, viz., Donations on account of Law Costs in the case of Kidd *v.* the Society		120 0 0	
Total Income		2,282 15 9	
To Cardiff Meeting		8,420 6 9	
			10,703 2 6
			£14,523 19 1

Balance-Sheet,

LIABILITIES.		£. s. d.	£. s. d.
To Capital:—			
Surplus, 30th June, 1872		29,466 0 2	
Less:—			
Surplus of Expenditure over Income during the Half-year viz.—	£. s. d.		
Expenditure	3,250 19 1		
Income	2,282 15 9		
	968 3 4		
Cardiff Meeting:— Difference between Receipts and Expenditure, the latter exceeding the former by	566 4 1		
Country Meeting Plant:— Half-year's Interest and Depreciation..	211 18 7		
		1,746 6 0	
			£27,719 14 2

BRIDPORT, *Finance Committee,*

QUILTER, BALL, & Co., *Accountants.*

SOCIETY OF ENGLAND.

FROM 1ST JULY TO 31ST DECEMBER, 1872. CR.

	£ s. d.	£ s. d.	£ s. d.
By Expenditure:—			
Establishment:—			
Salaries and Wages	467 6 0		
House and Office Expenses, Rent, &c.	438 9 6		
		905 15 6	
Journal:—			
Printing and Stitching	512 6 8		
Postage and Delivery	168 5 0		
Essays and Reports	237 11 0		
Map, Engravings, &c.	136 6 7		
Advertising	5 12 0		
		1,060 1 3	
Chemical:—			
Consulting Chemist's Salary		150 0 0	
Veterinary:—			
Grant to Royal Veterinary College (one year)		150 0 0	
Botanical:—			
Consulting Botanist's Salary		50 0 0	
Farm Inspection:—			
Prize	50 0 0		
Expenses of Judging	202 16 6		
		252 16 6	
Postage and Carriage		30 17 4	
Advertising		5 3 0	
Sundries:—			
Law Expenses	600 0 0		
Preparing Show Yard Accounts for Lord Vernon's Committee	46 5 6		
		646 5 6	
Total Expenditure			3,250 19 1
By Capital Account:—			
Country Meeting Plant			235 15 0
By Country Meetings:—			
Cardiff		10,303 11 10	
Hull		241 16 8	
			10,545 8 6
			14,032 2 7
By Balance in hand, 31st December:—			
Bankers		411 10 10	
Secretary		80 5 8	
			491 16 6
			£14,523 19 1

1ST DECEMBER, 1872.

ASSETS.	£. s. d.
By Cash in hand	491 16 6
By New 3 per Cent. Stock 24,112*l.* 7*s.* 9*d.* cost *	22,920 7 1
By Books and Furniture in Society's House	1,451 17 6
By Country Meeting Plant	2,613 16 5
	27,477 17 6
At Debit of Hull Meeting	241 16 8
	£27,719 14 2

* *Value at* 91¾ = £22,176 6*s.* 8¼*d.*

Mem.—The above Assets are exclusive of the amount recoverable in respect of arrears of Subscription to 31st December, 1872, which at that date amounted to 956*l.*

Examined, audited, and found correct, this 17th day of February, 1873.

FRANCIS SHERBORN,
A. H. JOHNSON,
HENRY CANTRELL,
} *Auditors on behalf of the Society.*

ROYAL AGRICULTURAL

Dr. YEARLY CASH ACCOUNT,

	£. s. d.	£. s. d.	£. s. d.
To Balance in hand, 1st Jan. 1872:—			
Bankers	. .	304 13 5	
Secretary	. .	63 12 8	
			368 6 1
To Income:—			
Dividends on Stock	. .	708 6 0	
Subscriptions:—			
Governors' Life-Compositions	420 0 0		
Governors' Annual	290 0 0		
Members' Life-Compositions	1134 0 0		
Members' Annual	3754 19 0		
		5,598 19 0	
Journal:—			
Sales, (1½ year)	251 19 8		
Advertisements	109 3 7		
		361 3 3	
Interest on Deposit Account	. .	46 7 6	
Sundries, viz.:—			
Donations on Account of Law Costs in the case of Kidd *v.* the Society	. .	120 0 0	
Total Income	. .	. .	6,834 15 9
To Country Meetings:—			
Wolverhampton	. .	2 18 0	
Cardiff	. .	13,078 15 10	
			13,081 13 10
			£20,284 15

OCIETY OF ENGLAND.

OM 1ST JANUARY TO 31ST DECEMBER, 1872. CR.

	£. s. d.	£. s. d.	£. s. d.
By Expenditure:—			
Establishment:—			
Salaries and Wages	935 18 0		
House and Office Expenses, Rent, &c.	846 5 3		
		1,782 3 3	
Journal:—			
Printing and Stitching	888 11 8		
Postage and Delivery	330 2 6		
Essays and Reports	382 1 0		
Map, Engravings, &c.	161 12 7		
Advertising	12 0 6		
		1,774 8 3	
Chemical:—			
Consulting Chemist's Salary	300 0 0		
Grant for Investigations	200 0 0		
		500 0 0	
Veterinary:—			
Royal Veterinary College, (1 year)	. .	150 0 0	
Botanical:—			
Consulting Botanist's Salary	. .	100 0 0	
Education	. .	48 6 6	
Farm Inspection:—			
Advertising, &c.	30 13 6		
Prize	50 0 0		
Expenses of Judging	202 16 6		
		283 10 0	
Advertising	. .	7 2 0	
Postage and Carriage	. .	76 4 9	
Sundries:—			
Law Expenses	624 0 6		
Expenses of Inspection Committee	18 6 2		
Preparing Accounts of Show-yard Works for use of Lord Vernon's Committee	46 5 6		
		688 12 2	
Subscriptions (paid in error) returned	. .	5 0 0	
Total Expenditure	. . .	. .	5,415 6 11
By Capital Account:—			
Country Meeting Plant	. .	. .	235 15 0
By Country Meetings:—			
Wolverhampton	. .	498 0 8	
Cardiff	. .	13,401 19 11	
Hull	. .	241 16 8	
			14,141 17 3
By Balance in hand, 31st Dec.:—			
Bankers	. .	411 10 10	
Secretary	. .	80 5 8	491 16 6
			£20,284 15 8

COUNTRY MEETING ACCOUNT, CARDIFF 1872.

Receipts.

	£.	s.	d.
Subscription from Cardiff	2,000	0	0
Admissions to Show Yard by Payment	6,290	13	6
Admissions by Season Tickets	790	15	0
Admissions to Grand Stand	256	6	2
Sale of Catalogues	494	6	6
Implement Exhibitors' Payments for Shedding	1,577	15	1
Non-Members' Fees for entry of Implements	174	0	0
Fees for entry of Live Stock	581	19	0
Fees for Horse Boxes and Stalls	213	0	0
Fees for entry of Cheese and Butter	9	10	0
Fees for entry of Cottage Plans	22	10	0
Premium for Supply of Refreshments	325	0	0
Premium for Cloak Rooms, Lavatories, &c.	55	0	0
Fines for Non-Exhibition of Live-Stock	26	10	0
Extra Lines and Fines for Non-Exhibition of Implements	80	13	0
Sale of Wheat and other Corn	253	1	0
	13,150	19	3
Balance of Expenditure over Receipts	602	5	6

Expenditure.

	£.	s.	d.	£.	s.	d.
Show Yard Works:—viz. Carriage, Storage, erecting and Painting, taking to pieces, Packing and Insurance of Permanent Buildings, and other Plant	561	7	6			
Implement Sheds	1152	4	3			
Seeds, Models, Cheese, Butter, and Cottage Plans Sheds	435	12	6			
Stock Sheds, 759*l.* 7*d.*; Horse Boxes, 402*l.* 3*s.* 5*d.*	1161	4	0			
Hurdles, Fences, Gates, &c.	449	4	2			
Tents and Fittings, 82*l.* 13*s.*; Awnings, 61*l.* 10*s.* 2*d.*	144	3	2			
Grand Stand, 112*l.* 16*s.*; Lavatories, &c., 251*l.* 15*s*	364	11	0			
Platforms, &c., inside Entrances	73	12	6			
Other Works	359	0	9			
Trial Yard	548	15	2			
Surveyor	187	18	3			
				5,437	13	3
Roads and Approaches to Show Yard				188	11	3
Judges: Implements, 249*l.* 10*s.*; Stock, 259*l.* 10*s.* 11*d.*; Cheese and Butter, 10*l.*; Cottage Plans, 30*l.* 15*s.* 6*d.*				549	16	5
Inspectors: Veterinary, 52*l.* 13*s.*; Shearing, 14*l.* 16*s.* 8*d.*				67	9	8
Consulting Engineer and Assistants				337	12	5
Police: Metropolitan, 252*l.* 8*s.* 6*d.*; Local, 24*l.* 10*s.*				276	18	6
Clerks and Assistants, &c.: Secretary and official Staff, 67*l.*; Hon. Director, 38*l.* 8*d.*; Bankers, 23*l.* 2*s.*				128	2	8
Assistant Steward of Implements				44	2	0
Foreman: Implements, 25*l.* 7*s.* 1*d.*; Trial Yard, 10*l.*; Stock Yard, 15*l.* 16*s.* 8*d.*; Horses, 11*l.* 10*s.*; Cattle, 9*l.* 9*s.*; Fodder, 13*l.* 13*s.*				85	15	9
Yardmen, Labourers, Foddermen, Grooms				212	8	6
Index-Clerk and Money Takers, 64*l.* 14*s.* 1*d.*; Money-changer and Door-keepers, 48*l.* 2*s.* 3*d.*				112	16	4
Refreshments for Stewards, Judges, and other Officials				182	18	10
Lodgings for ditto				186	3	0
Catalogues: Implements, 263*l.*; Awards, 5*l.* 14*s.*; Stock, 121*l.* 2*s.*; Awards, 15*l.* 3*s.*; Plan of Yard, 15*l.* 15*s.*; Sellers, 33*l.* 19*s.*; Carriage &c., 16*l.* 15*s.*				471	8	0
Printing				417	7	3
Advertising and Bill Posting				511	14	3
Hay, 146*l.* 4*s.* 2*d.*; Straw, 190*l.* 11*s.* 1*d.*; Green Food, 228*l.* 18*s.* 2*d.*				565	13	5
Wheat in the Straw, Barley, Oats, and Clover Seed				500	19	9
Postage, Telegrams, Carriage, Stationery, Badges, &c.				105	4	0
Repairs, Insurance, and Carriage of Testing Machinery, and Sundries				173	2	2
Hire of Engines, 17*l.* 11*s.*; Horse Hire, 42*l.* 5*s.*; Cabs for Stewards, 9*l.* 16*s.* 6*d.*				69	12	6
Coals, 11*l.* 6*s.* 2*d.*; Fire Engine Men, 5*l.* 5*s.*				16	11	2
Mowing, Rolling, and Cleaning Show Yard				22	3	0
Gratuities to Post-Office Clerks, Letter Carriers, &c., 5*l.* 10*s.*; Shorthand Writer, 4*l.* 11*s.*; Thrashing out Corn, 2*l.* 17*s.*				12	18	0
Hire of Harmonium, &c., 2*l.* 8*s.*; Compensation to Groom injured, 7*l.* 7*s.*				9	15	0
Drugs, 1*l.* 12*s.* 6*d.*; Forks and Prongs, &c., 1*l.* 19*s.*; Petty Payments, 2*l.* 4*s.* 2*d.*				5	5	8
Rosettes				13	10	0
Prizes: Stock, 2,770*l.*; Implements, 265*l.*; Medals, 12*l.* 12*s.*				3,047	12	0
				£13,753	4	9

Hull Meeting, 1873:

ON MONDAY THE 14TH OF JULY, AND FOUR FOLLOWING DAYS.

SCHEDULE OF PRIZES.

I.—LIVE-STOCK PRIZES.

Reference Number in Certificates.	HORSES.	First Prize.	Second Prize.	Third Prize.
Class		£.	£.	£.
1	Agricultural Stallion, foaled before 1st Jan. 1871, *not qualified to compete as Clydesdale or Suffolk*	25	15	5
2	Agricultural Stallion, foaled in the year 1871, *not qualified to compete as Clydesdale or Suffolk* ..	20	10	5
3	Clydesdale Stallion, foaled before the 1st Jan. 1871	25	15	5
4	Clydesdale Stallion, foaled in the year 1871 ..	20	10	5
5	Suffolk Stallion, foaled before the 1st of Jan. 1871	25	15	5
6	Suffolk Stallion, foaled in the year 1871	20	10	5
7	Thorough-bred Stallion, suitable for getting hunters	50	25	10
8	Stallion, above 14 hands but not exceeding 15 hands 2 inches, suitable for getting Hackneys ..	20	10	5
9	Pony Stallion, not exceeding 14 hands	15	10	5
10	Agricultural Mare, in foal, or with foal at foot, *not qualified to compete as Clydesdale or Suffolk* ..	20	10	5
11	Clydesdale Mare, in foal, or with foal at foot ..	20	10	5
12	Suffolk Mare, in foal, or with foal at foot	20	10	5
13	Mare, in foal, or with foal at foot, suitable for breeding Hunters	25	15	5
14	Mare, above 14 hands, but not exceeding 15 hands 1 inch, in foal, or with foal at foot, suitable for breeding Hackneys	20	10	5
15	Pony Mare, not exceeding 14 hands	10	5	5
16	Agricultural Filly, two years old, *not qualified to compete as Clydesdale or Suffolk*	15	10	5
17	Clydesdale Filly, two years old	15	10	5
18	Suffolk Filly, two years old	15	10	5
19	Pair of Agricultural Draught Horses, worked regularly at plough and harrow during the year 1873	20*	..	..
20	Pair of Agricultural Geldings, two years old ..	15†	10†	..

No Third Prize will be given unless at least Six animals be exhibited, and no Second Prize will be given unless at least Three animals be exhibited, except on the special recommendation of the Judges.

* Offered by the Holderness Agricultural Society.
† Offered by Beverley and the neighbourhood.

Reference Number in Certificates.	HORSES—*continued.*	First Prize.	Second Prize.	Third Prize.	Fourth Prize.
Class		£.	£.	£.	£.
21	Hunter, Mare or Gelding, five years old and upwards, having not less than three crosses of blood. English breed	15*	10*	..	..
22	Hunter, Mare or Gelding, four years old, equal to carrying 14 stones over any hunting country, and to have not less than three crosses of blood	35†	15†	..	..
23	Hunter, Mare or Gelding, three years old	15‡	5‡	..	..
24	Hunter Gelding, two years old, with not less than three crosses of blood	15†	10†	..	..
	A Champion Prize of £100 *for the best Hunter (mare or gelding) in the yard, of any age, equal to carrying* 14 *to* 15 *stones over any hunting country. Offered by the Local Committee*				
25	Roadster Hackney (nag or mare), from four to eight years old, and from 14 hands 2 inches to 15 hands 2 inches high	20§	10§	..	..
26	Jackass, not under 13 hands, for getting mules for agricultural purposes	25‖	15‖	10‖	..
27	Mule, not under 15 hands, for agricultural purposes	25‖	15‖	10‖	..

No Second Prize will be given unless at least Three animals be exhibited, except on the special recommendation of the Judges.

* Offered by Driffield and the neighbourhood.
† Offered by Beverley and the neighbourhood.
‡ Offered by some Lincolnshire Tenant-farmers.
§ Offered by Market Weighton and the neighbourhood.
‖ Offered by Edward Pease, Esq., Darlington.

CATTLE.

(All Ages calculated to July 1st, 1873).

Shorthorn.

Class		First Prize £.	Second Prize £.	Third Prize £.	Fourth Prize £.
28	Bull, above three years old	30	20	15	10
29	Bull, above two and not exceeding three years old	25	15	10	5
30	Yearling Bull, above one and not exceeding two years old	25	15	10	5

No Third Prize will be given unless at least Six animals be exhibited, and no Second Prize will be given unless at least Three animals be exhibited; and in Classes 28, 29 *and* 30 *no Fourth Prize will be given unless at least Ten animals be exhibited, except on the special recommendation of the Judges.*

Reference Number in Certificates.	CATTLE—*continued.*	First Prize.	Second Prize.	Third Prize.
Class		£.	£.	£.
31	Bull-Calf, above six and not exceeding twelve months old	15	10	5
32	Cow, above three years old	20	10	5
33	Heifer, in-milk or in-calf, not exceeding three years old	15	10	5
34	Yearling Heifer, above one and not exceeding two years old	15	10	5
35	Heifer-Calf, above six and under twelve months old	10	5	..
	HEREFORD.			
36	Bull, above three years old	25	15	5
37	Bull, above two and not exceeding three years old	25	15	5
38	Yearling Bull, above one and not exceeding two years old	25	15	5
39	Bull-Calf, above six and not exceeding twelve months old	10	5	..
40	Cow, above three years old	20	10	5
41	Heifer, in-milk or in-calf, not exceeding three years old	15	10	5
42	Yearling Heifer, above one and not exceeding two years old	15	10	5
43	Heifer-Calf, above six and under twelve months old	10	5	..
	DEVON.			
44	Bull, above three years old	25	15	5
45	Bull, above two and not exceeding three years old	25	15	5
46	Yearling Bull, above one and not exceeding two years old	25	15	5
47	Bull-Calf, above six and not exceeding twelve months old	10	5	..
48	Cow, above three years old	20	10	5
49	Heifer, in-milk or in-calf not exceeding three years old	15	10	5
50	Yearling Heifer, above one and not exceeding two years old	15	10	5
51	Heifer-Calf, above six and under twelve months old	10	5	..
	JERSEY.			
52	Bull, above one year old	10	5	..
53	Cow, above three years old	10	5	..
54	Heifer, in-milk or in-calf, not exceeding three years old	10	5	..
	No Third Prize will be given unless at least Six animals be exhibited, and no Second Prize will be given unless at least Three Animals be exhibited; and in Classes 28, 29, *and* 30 *no Fourth Prize will be given unless at least Ten animals be exhibited, except on the special recommendation of the Judges.*			

Reference Number in Certificates.	CATTLE—*continued.*	First Prize.	Second Prize.	Third Prize.
Class	GUERNSEY.	£.	£.	£.
55	Bull, above one year old..	10	5	..
56	Cow, above three years old	10	5	..
57	Heifer, in-milk or in-calf, not exceeding three years old	10	5	..
	GALLOWAY.			
58	Bull, above two years old	10	5	..
59	Cow, above three years old	10	5	..
60	Heifer, in-milk, or in-calf, under three years old	10	5	..
	AYRSHIRE.			
61	Bull, above two years old	10	5	..
62	Cow, above three years old	10	5	..
63	Heifer, in-milk or in-calf, under three years old	10	5	..
	OTHER ESTABLISHED BREEDS.			
	Not including the Shorthorn, Hereford, Devon, Jersey, Guernsey, Ayrshire, or Galloway.			
64	Bull, above one year old	10	5	..
65	Cow, above three years old	10	5	..
66	Heifer, in-milk or in-calf, not exceeding three years old	10	5	..
	CATTLE OF ANY BREED.			
67	Pair of Dairy Cows, for breeding and milking purposes	10*	5*	..
68	Pair of three years old Heifers, in-milk, or in-calf	10*	5*	..
69	Pair of two-and-a-half years old Steers	15*	5*	..

No Third Prize will be given unless at least Six animals be exhibited, and no Second Prize will be given unless at least Three animals be exhibited, and in classes 28, 29 *and* 30 *no Fourth Prize will be given unless at least Ten animals be exhibited, except on the special recommendation of the Judges.*

* Offered by the Hull Butchers.

Reference Number in Certificates.	SHEEP.	First Prize.	Second Prize.	Third Prize.
Class	LEICESTER.	£.	£.	£.
70	Shearling Ram	20	10	5
71	Ram of any other age	20	10	5
72	Pen of Five Shearling Ewes, of the same flock ..	15	10	5
	COTSWOLD.			
73	Shearling Ram	20	10	5
74	Ram of any other age	20	10	5
75	Pen of Five Shearling Ewes, of the same flock ..	15	10	5
	LINCOLNS.			
76	Shearling Ram	20	10	5
77	Ram of any other age	20	10	5
78	Pen of Five Shearling Ewes, of the same flock ..	15	10	5
	BORDER LEICESTER.			
79	Shearling Ram	20	10	5
80	Ram of any other age	20	10	5
81	Pen of Five Shearling Ewes, of the same flock ..	15	10	5
	OXFORDSHIRE DOWN.			
82	Shearling Ram	20	10	5
83	Ram of any other age	20	10	5
84	Pen of Five Shearling Ewes, of the same flock ..	15	10	5
	LONG-WOOLS OF ANY BREED.			
85	Pen of Twenty-five Shearling Gimmers, of the same flock	25	15	10
	SOUTHDOWN.			
86	Shearling Ram	20	10	5
87	Ram of any other age	20	10	5
88	Pen of Five Shearling Ewes, of the same flock ..	15	10	5
	No Third Prize will be given unless at least Six animals be exhibited, and no Second Prize will be given unless at least Three animals be exhibited, except on the special recommendation of the Judges. This rule is applied to the Ewe, Lamb, Gimmer, and Wether Classes by substituting the word "pens" for "animals."			

Reference Number in Certificates.	SHEEP—*continued.*	First Prize.	Second Prize.	Third Prize.
Class	SHROPSHIRE.	£.	£.	£.
89	Shearling Ram	20	10	5
90	Ram of any other age	20	10	5
91	Pen of Five Shearling Ewes, of the same flock ..	15	10	5
	HAMPSHIRE AND OTHER SHORT-WOOLLED BREEDS.			
	Not qualified to compete as Southdown or Shropshire.			
92	Shearling Ram	10	5	..
93	Ram of any other age	10	5	..
94	Pen of Five Shearling Ewes, of the same flock ..	10	5	..
	CHEVIOTS.			
95	Shearling Ram	10	5	..
96	Ram of any other age	10	5	..
97	Pen of Five Ewes of any age, of the same flock ..	10	5	..
	BLACK-FACED MOUNTAIN SHEEP.			
98	Shearling Ram	10	5	..
99	Ram of any other age	10	5	..
100	Pen of Five Ewes of any age, of the same flock ..	10	5	..
	MOUNTAIN SHEEP.			
	Including Lonk, Herdwick, and other breeds.			
101	Shearling Ram	10	5	..
102	Ram of any other age	10	5	..
103	Pen of Five Ewes of any age, of the same flock ..	10	5	..
	SHEEP OF ANY BREED.			
104	Pen of Ten Shearling Wether Sheep of the same flock	*10	*5	

No Third Prize will be given unless at least Six animals be exhibited, and no Second Prize will be given unless at least Three animals be exhibited, except on the special recommendation of the Judges. This rule is applied to the Ewe, Lamb, Gimmer and Wether Classes by substituting the word "pens" for "animals."

* Offered by the Hull Butchers.

Reference Number in Certificates.	PIGS.	First Prize.	Second Prize.	Third Prize.
	Large White Breed.			
Class		£.	£.	£.
105	Boar, above twelve months old	10	5	..
166	Boar, above six months and not exceeding twelve months old	10	5	..
107	Breeding Sow	10	5	..
103	Pen of three Breeding Sow-Pigs of the same litter, above four and under eight months old	10	5	..
	Small White Breed.			
109	Boar, above twelve months old	10	5	..
110	Boar, above six months and not exceeding twelve months old	10	5	..
111	Breeding Sow	10	5	..
112	Pen of three Breeding Sow-Pigs of the same litter, above four and under eight months old	10	5	..
	Small Black Breed.			
113	Boar, above twelve months old	10	5	..
114	Boar, above six months and not exceeding twelve months old	10	5	..
115	Breeding Sow	10	5	..
116	Pen of three Breeding Sow-Pigs of the same litter, above four and under eight months old ..	10	5	..
	Berkshire Breed.			
117	Boar, above twelve months old	10	5	..
118	Boar, above six months and not exceeding twelve months old	10	5	..
119	Breeding Sow	10	5	..
120	Pen of three Breeding Sow-Pigs of the same litter, above four and under eight months old	10	5	..
	Other Breeds.			
	Not eligible to compete in any of the preceding Classes.			
121	Boar	10	5	..
122	Breeding Sow	10	5	..
123	Pen of three Breeding-Sow Pigs of the same litter above four and under eight months old	10	5	..
	No Second Prize will be given unless at least Three animals be exhibited, except on the special recommendation of the Judges.			

II.—Implement and Machinery Prizes offered by the Society.

Section I.—Ploughs.

Subsection A.—Wheel Ploughs.

Class		£.
1.	For the best Plough, not exceeding 2 cwt	10
	For the second best ditto	5

To be tested at 4 to 6 inches deep, on light land only, as far as practicable.

Extreme length from point of share to end of breast not to exceed 4 feet.

2.	For the best Plough, not exceeding 2½ cwt..	10
	For the second best ditto	5

To be tested at 4 to 7 inches deep, on light and mixed land as far as practicable.

Extreme length from point of share to end of breast not to exceed 4½ feet.

3.	For the best Plough, not exceeding 3 cwt..	10
	For the second best ditto	5

To be tested at 5 to 8 inches deep, on mixed soil and heavy land as far as practicable.

Extreme length from point of share to end of breast not to exceed 4½ feet.

Subsection B.—Swing Ploughs.

4.	For the best Plough, not exceeding 2½ cwt.	10
	For the second best ditto	5

To be tested at 4 to 7 inches deep, on light and mixed land as far practicable.

Extreme length from point of share to end of breast not to exceed 4½ feet.

Subsection C.—Double-furrow Ploughs.

5.	For the best Plough, not exceeding 3½ cwt.	10
	For the second best ditto	5

To be tested at 4 to 6 inches deep, on light land only, as far as practicable.

Extreme length from point of share to end of breast not to exceed 4 feet.

6.	For the best Plough, not exceeding 5 cwt..	10
	For the second best ditto	5

To be tested at 4 to 7 inches deep, on light and mixed land, as far as practicable.

Extreme length from point of share to end of breast not to exceed 4½ feet.

Subsection D.—Multiple-furrow Ploughs.

7.	For the best Plough turning three or more furrows, not exceeding 6 cwt...	10

To be tested at 4 to 6 inches deep, on light land only, as far as practicable.

Extreme length from point of share to end of breast not to exceed 4 feet.

Note.—*Such Ploughs in Subsections A, B, C, and D, as the Judges may select, will be tested on stubble as well as lea.*

		£.
	SUBSECTION E.—SUBSOIL PLOUGHS.	
8.	Best Subsoil Ploughs	5
	To follow an ordinary plough and work from 6 to 12 inches below the furrow bottom.	
9.	Best arrangement of Subsoiler attached to a Single-furrow Plough for ploughing and subsoiling at one operation	5
	This Plough must be able to plough 6 inches deep, and subsoil 4 to 6 inches deeper.	
10.	Best arrangement of Subsoiler attached to a Double-furrow Plough for ploughing and subsoiling at one operation	5
	This Plough must be able to plough 6 inches deep, and subsoil 4 to 6 inches deeper.	
	SUBSECTION F.—ONE-WAY PLOUGH.	
11.	For the best Single-furrow One-way Plough	5
12.	For the best Double-furrow One-way Plough	5
	All the One-way Ploughs to be tested at 4 to 7 inches deep, on light and mixed land, as far as practicable, and on both lea and stubble.	
	SUBSECTION G.—DOUBLE MOULDBOARDS OR RIDGING PLOUGHS.	
13.	For the best Plough, not exceeding 2½ cwt.	5
	To be tested in ridging up land from the flat, moulding up Potatoes, and opening water furrows after ploughing.	
	SUBSECTION H.—PARING PLOUGH.	
14.	For the best Paring Plough	5
	SUBSECTION I.—PULVERIZER.	
15.	For the best Plough for leaving the furrow-slice pulverized	5
	To be tested at 6 to 8 inches deep, on light and mixed land, as far as practicable.	
	SUBSECTION K.—MISCELLANEOUS.	
16.	For the best Plough not qualified to compete in any of the foregoing classes	5
	SECTION II.—HARROWS.	
17.	For the best Light Harrow	10
	For the second best ditto	5
18.	For the best Heavy Harrow	10
	For the second best ditto	5
19.	For the best Chisel Harrow	10
	For the second best ditto	5
20.	For the best Chain Harrow	5
21.	For the best Drag Harrow	5
22.	For the best Harrow, not qualified to compete in the preceding Classes	5
	SECTION III.—ROLLERS AND CLOD-CRUSHERS.	
23.	For the best Light Roller	10
	For the second best ditto	5
24.	For the best Heavy Roller	10
	For the second best ditto	5
25.	For the best Clod-crusher	10
	For the second best ditto	5
26.	For the best Roller or Clod-crusher, not qualified to compete in the preceding Classes	10

Section IV.—Cultivators and Scarifiers.

		£.
27.	For the best Cultivating Implement for light land	15
	For the second best ditto	10
28.	For the best Cultivating Implement for heavy land	15
	For the second best ditto	10
29.	For the best Broadshare	10
30.	For the best Implement for cultivating or scarifying purposes, not qualified to compete in the preceding Classes	10
	For the second best ditto	5

Section V.—Digging Machines.

31.	For the best Digging Machine	10

Section VI.—Potatoe Ploughs and Diggers.

32.	For the best Plough for raising Potatoes	10
33.	For the best Machine or Digger for raising Potatoes	10

Special Prize.

For the best combined Stacking Machine 25

The Society reserves to itself the right of postponing the Trial of the Implements in classes 32 and 33 to a later period than the Hull Meeting, if the Potatoe crops should not then be sufficiently forward.

Miscellaneous awards to Agricultural Articles not included in the Quinquennial rotation .. .. Ten Silver Medals.

CONDITIONS APPLYING TO CERTAIN CLASSES OF LIVE STOCK ONLY.

CATTLE.

1. No bull above two years old will be eligible for a prize unless certified to have served not less than three different cows (or heifers) within the three months preceding the 1st of June in the year of the Show.

2. All bulls above one year old shall have rings or "bull-dogs" in their noses, and be provided with leading sticks.

3. No cow will be eligible for a prize unless certified either at the date of entry or between the date of entry and that of the Show, to have had a living calf, or that the calf, if dead, was born at its proper time, within the twelve months preceding the date of the Show.

4. No heifer, except yearlings, entered as in-calf, will be eligible for a prize unless she is certified to have been bulled before the 31st of March in the year of the Show, nor will her owner afterwards receive the prize until he shall have furnished the Secretary with a further certificate before the 31st of January in the subsequent year, that she produced a living calf; or that the calf, if dead, was born at its proper time.

5. Shorthorns.—Each animal entered in the Shorthorn Classes, must be certified by the Exhibitor to have not less than four crosses of Shorthorn blood which are registered in the herd book.

HORSES.

6. All foals must be the offspring of the mare along with which they are exhibited; and the sire of the foal must be given on the certificate of entry as well as the sire of the mare.

7. No mare will be eligible for a prize unless certified either at the date of entry, or between the date of entry and that of the Show, and to have had a living foal—or that the foal, *if dead*, was born at its proper time, in the year of the Show;—or in the event of a mare being exhibited *without* a foal at foot, a certificate shall be produced at the time of entry of her having been served, and the prize shall be withheld till a certificate be produced of her having produced a foal.

8. No veterinary inspection of horses will be required except when considered necessary by the Judges, who will be accompanied by the Veterinary Inspectors.

9. A charge of 1*l*. for the accommodation of a horse-box, in addition to the entry-fee, will be made for each entry for stallions and mares in-foal, or with foals at foot.

10. A charge of 10*s*. will be made, in addition to the entry-fee, for the accommodation of a stall for each animal in the other Horse Classes.

Sheep.

11. All rams, except shearlings, must have been used in the preceding year.

12. Sheep exhibited for any of the prizes must have been *really and fairly shorn bare* after the 1st of April in the year of the Exhibition; and the date of such shearing must form part of the Certificate of Entry. Inspectors will be appointed by the Council to examine the sheep on their admission to the Show-Yard, with instructions to report to the Stewards any cases in which the sheep have not been *really and fairly shorn bare.*

13. Sheep unfairly prepared for Show by oiling or colouring may be disqualified on the recommendation of the Inspectors of Shearing.

Pigs.

14. The three sow-pigs in each pen must be of the same litter.

15. The breeding sows in Classes 107, 111, 115, 119, and 122, shall be certified to have had a litter of live pigs within the six months preceding the Show, or to be in-pig at the time of entry, so as to produce a litter before the 1st of September following. In the case of in-pig sows, the prize will be withheld until the Exhibitor shall have furnished the Secretary with a certificate of farrowing, as above.

16. No sow, if above eighteen months old, that has not produced a litter of live pigs, shall be eligible to compete in any of the classes.

17. The Judges of pigs will be instructed, with the sanction of the Stewards, to withhold prizes from any animals which shall appear to them to have been entered in a wrong class.

18. All pigs exhibited at the Country Meetings of the Society shall be subjected to an examination of their mouths by the Veterinary Inspector of the Society; and should the state of dentition in any pig indicate that the age of the animal has not been correctly returned in the Certificate of Entry, the Stewards shall have power to disqualify such pig, and shall report the circumstance to the Council at its ensuing Monthly Meeting. No pig shall be oiled or coloured while in the Show-Yard.

19. If a litter of pigs be sent with a breeding sow, the young pigs must be the produce of the sow, and must not exceed two months old.

20. All disqualifications will be published in the awards of the Judges.

RULES OF ADJUDICATION.

1. As the object of the Society in giving prizes for cattle, sheep, and pigs, is to promote improvement in *breeding* stock, the Judges in making their awards will be instructed not to take into their consideration the present value to the butcher of animals exhibited, but to decide according to their relative merits for the purpose of *breeding*.

2. If, in the opinion of the Judges, there should be equality of merit, they will be instructed to make a special report to the Council, who will decide on the award.

3. The Judges will be instructed to withhold any prize if they are of opinion that there is not sufficient merit in any of the stock exhibited for such prize to justify an award.

4. The Judges will be instructed to give in a *Reserved Number* in each class of live stock; viz., which animal would, in their opinion, possess sufficient merit for the prize, in case the animal to which the prize is awarded should subsequently become disqualified.

5. In the classes for stallions, mares, and fillies, the Judges in awarding the prizes will be instructed, in addition to symmetry, to take activity and strength into their consideration.

6. The attention of the Stewards and Judges is particularly called to the conditions applying to pigs. The Senior Steward of Live Stock is requested to report any malpractices on the part of Exhibitors, and any person found guilty will not be allowed to exhibit at future meetings of the Society.

CONDITIONS RELATING TO IMPLEMENTS.

General Conditions as regards Ploughs.

The specified weights of the ploughs in each class are to be taken when fitted with two wheels, and with the breast, share, and coulter, as used at work, but are not to include the skim-coulter or any other occasional extra parts, such as drag-weight and chain, although employed during the trial.

The standard of excellence of work will be the same as that laid down by the Society for the Newcastle Meeting, viz.:—

> "That the plough should cut the sole of the furrow perfectly flat, leave the landside clear and true, lay the furrow slices with uniformity, with perpendicular cut of the landside, leaving a roomy horse walk. That it should have an efficient skim-coulter, be light in draught, simple, strong and economical in construction."

Ploughs will be tested by a dynamometer, and drawn by steam power during such test.

Each Plough must go at least one round drawn by steam, and with the dynamometer attached, but not registering, so that it may open its own work prior to having its draught tested. The draught will be registered on not less than four different furrows, and averaged to ensure accuracy.

Each competitor may use a new or sharp share and coulter during the dynamometer trials, but these must be of the same shape and make as those which he has used during the rest of the trial.

When tested on the dynamometer, each Plough shall have a share cutting the same width of ground, namely:—

> For a 9-inch furrow, not less than 7½ inches wide; and for a wide 12-inch furrow, not less than 10 inches, measuring across the wing.

The length from the point of the share to the end of the breast will be measured along the centre of the breast.

*** Forms of Certificate for entry, as well as Prize-Sheets for the Hull Meeting, containing the whole of the conditions and regulations, may be obtained at the Office of the Society, No. 12, Hanover Square, London, W.

DATES OF ENTRY.

Certificates for the entry of Implements for the Hull Meeting must be forwarded to the Secretary of the Society, No. 12, Hanover Square, London, W., by the 1st of May, and Certificates for the entry of Live Stock by the 1st of June. Certificates received after those respective dates will not be accepted, but returned to the persons by whom they have been sent.

The Prizes of the Royal Agricultural Society of England, and all Prizes offered by the Hull Local Committee, and other Donors, are open to general competition.

Members' Veterinary Privileges.

I.—Serious or Extensive Diseases.

No. 1. Any Member of the Society who may desire professional attendance and special advice in cases of serious or extensive disease among his cattle, sheep, or pigs, will, on application to the Secretary, obtain the services of the Society's Veterinary Inspector, to visit the place where the disease prevails.

No. 2. The remuneration of the Inspector will be 2*l.* 2*s.* each day as a professional fee, and 1*l.* 1*s.* each day for personal expenses; and he will also be allowed to charge the cost of travelling to and from the locality where his services may have been required. The fees and expenses will be a charge against the applicant; but this charge may be reduced or remitted altogether at the discretion of the Council, on such course being recommended to them by the Veterinary Committee.

No. 3. The Inspector, on his return from visiting the diseased stock, will report to the Committee, in writing, the results of his observations and proceedings, which Report will be laid before the Council.

No. 4. When contingencies arise to prevent a personal discharge of the duties confided to the Inspector, he may, subject to the approval of the Committee, name some competent professional person to act in his stead, who shall receive the same rates of remuneration.

II.—Ordinary or Other Cases of Disease.

Members may obtain the attendance of the Veterinary Inspector on any case of disease by paying the cost of his visit, which will be at the following rates, viz., 2*l.* 2*s.* per diem, and travelling expenses.

III.—Consultations without visit.

Personal consultation with the Veterinary Inspector	5*s.*
Consultation by letter	5*s.*
Consultation necessitating the writing of three or more letters.	10*s.*
Post-mortem examination, and report thereon	10*s.*

A return of the number of applications during each half-year being required from the Veterinary Inspector.

IV.—Admission of Diseased Animals to the Veterinary College Investigations; Lectures, and Reports.

No. 1. All Members of the Society have the privilege of sending cattle, sheep, and pigs to the Infirmary of the Royal Veterinary College, on the same terms as if they were Members of the College; viz., by paying for the keep and treatment of cattle 10*s.* 6*d.* per week each animal, and for sheep and pigs "a small proportionate charge to be fixed by the Principal according to circumstances."

No. 2. The College has also undertaken to investigate such particular classes of disease, or special subjects connected with the application of the Veterinary art to cattle, sheep, and pigs, as may be named by the Council.

No. 3. In addition to the lectures now given by the Professor of Cattle Pathology to the pupils in the Royal Veterinary College, on special occasions the College undertake that one of the Professors shall also deliver such lectures before the Members of the Society, at their house in Hanover Square, as the Council shall desire.

No. 4. The Royal Veterinary College will authorise the Principal to furnish to the Council, quarterly, a detailed Report of the cases of cattle, sheep, and pigs treated in the Infirmary; and also Special Reports from time to time on any matter of unusual interest, which may come under the notice of the College.

By order of the Council,

H. M. JENKINS, *Secretary.*

Members' Privileges of Chemical Analysis.

The Council have fixed the following rates of Charge for Analyses to be made by the Consulting Chemist for the *bonâ-fide* use of Members of the Society; who (to avoid all unnecessary correspondence) are particularly requested, when applying to him, to mention the kind of analysis they require, and to quote its number in the subjoined schedule. The charge for analysis, together with the carriage of the specimens, must be paid to him by members at the time of their application.

No. 1.—An opinion of the genuineness of Peruvian guano, bone-dust, or oil-cake (each sample)	5*s.*
„ 2.—An analysis of guano; showing the proportion of moisture, organic matter, sand, phosphate of lime, alkaline salts, and ammonia	10*s.*
„ 3.—An estimate of the value (relatively to the average of samples in the market) of sulphate and muriate of ammonia, and of the nitrates of potash and soda	10*s.*
„ 4.—An analysis of superphosphate of lime for soluble phosphates only	10*s.*
„ 5.—An analysis of superphosphate of lime, showing the proportions of moisture, organic matter, sand, soluble and insoluble phosphates, sulphate of lime, and ammonia ..	£1.
„ 6.—An analysis (sufficient for the determination of its agricultural value) of any ordinary artificial manure	£1.
„ 7.—Limestone:—the proportion of lime, 7*s.* 6*d.*; the proportion of magnesia, 10*s.*; the proportion of lime and magnesia	15*s.*
„ 8.—Limestone or marls, including carbonate, phosphate, and sulphate of lime, and magnesia with sand and clay ..	£1.
„ 9.—Partial analysis of a soil, including determinations of clay, sand, organic matter, and carbonate of lime	£1.
„ 10.—Complete analysis of a soil	£3.
„ 11.—An analysis of oil-cake, or other substance used for feeding purposes; showing the proportion of moisture, oil, mineral matter, albuminous matter, and woody fibre; as well as of starch, gum, and sugar, in the aggregate	£1.
„ 12.—Analyses of any vegetable product	£1.
„ 13.—Analyses of animal products, refuse substances used for manure, &c.	from 10*s.* to 30*s.*
„ 14.—Determination of the "hardness" of a sample of water before and after boiling	10*s.*
„ 15.—Analysis of water of land drainage, and of water used for irrigation	£2.
„ 16.—Determination of nitric acid in a sample of water	£1.

N.B.—*The above Scale of Charges is not applicable to the case of persons commercially engaged in the Manufacture or Sale of any Substance sent for Analysis.*

The Address of the Consulting Chemist of the Society is, Dr. Augustus Voelcker, F.R.S., 11, Salisbury Square, London, E.C., to which he requests that all letters and parcels (postage and carriage paid) should be directed.

By order of the Council,

H. M. JENKINS, *Secretary.*

INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES FOR ANALYSIS.

ARTIFICIAL MANURES.—Take a large handful of the manure from three or four bags, mix the whole on a large sheet of paper, breaking down with the hand any lumps present, and fold up in tinfoil, or in oil silk, about 3 ozs. of the well-mixed sample, and send it to 11, Salisbury Square, Fleet Street, E.C., by post: or place the mixed manure in a small wooden or tin box, and send it by post. If the manure be very wet and lumpy, a larger boxful, weighing from 10 to 12 ozs., should be sent either by post or railway.

Samples not exceeding 4 ounces in weight may be sent by post, by attaching two penny postage stamps to the parcel.

Samples not exceeding 8 ounces, for three postage stamps.

Samples not exceeding 12 ounces, for four postage stamps.

The parcels should be addressed: Dr. Augustus Voelcker, 11, Salisbury Square, Fleet Street, London, E.C., and the address of the sender or the number or mark of the article be stated on parcels.

The samples may be sent in covers, or in boxes, bags of linen or other materials. No parcel sent by post must exceed 12 ozs. in weight, 1 foot 6 inches in length, 9 inches in width, and 6 inches in depth.

SOILS.—Have a wooden box made 6 inches long and wide, and from 9 to 12 inches deep, according to the depth of soil and subsoil of the field. Mark out in the field a space of about 12 inches square; dig round in a slanting direction a trench, so as to leave undisturbed a block of soil with its subsoil from 9 to 12 inches deep; trim this block or plan of the field to make it fit into the wooden box, invert the open box over it, press down firmly, then pass a spade under the box and lift it up, gently turn over the box, nail on the lid and send it by goods or parcel train to the laboratory. The soil will then be received in the exact position in which it is found in the field.

In the case of very light, sandy, and porous soils, the wooden box may be at once inverted over the soil and forced down by pressure, and then dug out.

WATERS.—Two gallons of water are required for analysis. The water, if possible, should be sent in glass-stoppered Winchester half-gallon bottles, which are readily obtained in any chemist and druggist's shop. If Winchester bottles cannot be procured, the water may be sent in perfectly clean new stoneware spirit-jars surrounded by wickerwork. For the determination of the degree of hardness before and after boiling, only one quart wine-bottle full of water is required.

LIMESTONES, MARLS, IRONSTONES, AND OTHER MINERALS.—Whole pieces, weighing from 3 to 4 ozs., should be sent enclosed in small linen bags, or wrapped in paper. Postage 2*d*., if under 4 ounces.

OILCAKES.—Take a sample from the middle of the cake. To this end break a whole cake into two. Then break off a piece from the end where the two halves were joined together, and wrap it in paper, leaving the ends open, and send parcel by post. The piece should weigh from 10 to 12 ozs. Postage, 4d. If sent by railway, one quarter or half a cake should be forwarded.

FEEDING MEALS.—About 3 ozs. will be sufficient for analysis. Enclose the meal in a small linen bag. Send it by post.

On forwarding samples, separate letters should be sent to the laboratory, specifying the nature of the information required, and, if possible, the object in view.

H. M. JENKINS, *Secretary.*

Members' Botanical Privileges.

The Council have provisionally fixed the following rates of Charge for the examination of Plants and Seeds for the *bonâ fide* use of Members of the Society, who are particularly requested, when applying to the Consulting Botanist, to mention the kind of examination they require, and to quote its number in the subjoined Schedule. The charge for examination must be paid to the Consulting Botanist at the time of application, and the carriage of all parcels must be prepaid.

No. 1.—A general opinion as to the genuineness and age of a sample of clover-seed (each sample)	5*s.*
„ 2.—A detailed examination of a sample of dirty or impure clover-seed, with a report on its admixture with seeds of dodder or other weeds (each sample)	10*s.*
„ 3.—A test examination of turnip or other cruciferous seed, with a report on its germinating power, or its adulteration with 000 seed (each sample)	10*s.*
„ 4.—A test examination of any other kind of seed, or corn, with a report on its germinating power (each sample) ..	10*s.*
„ 5.—Determination of the species of any indigenous British plant (not parasitic), with a report on its habits (each species)	5*s.*
„ 6.—Determination of the species of any epiphyte or vegetable parasite, on any farm-crop grown by the Member, with a report on its habits, and suggestions (where possible) as to its extermination or prevention (each species) ..	10*s.*
„ 7.—Report on any other form of plant-disease not caused by insects	10*s.*
„ 8.—Determination of the species of a collection of natural grasses indigenous to any district on one kind of soil (each collection)	10*s.*

INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES.

In sending seed or corn for examination the utmost care must be taken to secure a fair and honest sample. If anything supposed to be injurious or useless exists in the corn or seed, selected samples should also be sent.

In collecting specimens of plants, the whole plant should be taken up, and the earth shaken from the roots. If possible, the plants must be in flower or fruit. They should be packed in a light box, or in a firm paper parcel.

Specimens of diseased plants or of parasites should be forwarded as fresh as possible. Place them in a bottle, or pack them in tin-foil or oil-silk.

All specimens should be accompanied with a letter specifying the nature of the information required, and stating any local circumstances (soil, situation, &c.) which, in the opinion of the sender, would be likely to throw light on the inquiry.

N.B.—*The above Scale of Charges is not applicable in the case of Seedsmen requiring the services of the Consulting Botanist.*

Parcels or letters (Carriage or Postage prepaid) to be addressed to Mr. W. Carruthers, F.R.S., 25, Wellington Street, Islington, London.

H. M. JENKINS, *Secretary.*

Royal Agricultural Society of England.

1873-4.

President.

EDWARD HOLLAND.

Trustees.

Year when Elected.	
1857	Bridport, Viscount, *Cricket St. Thomas, Chard, Somersetshire.*
1850	Chesham, Lord, *Latimer, Chesham, Bucks.*
1861	Holland, Edward, *Dumbleton Hall, Evesham, Gloucestershire.*
1867	Kesteven, Lord, *Caswick, Stamford, Lincolnshire.*
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1860	Marlborough, Duke of, K.G., *Blenheim Park, Oxford.*
1846	Milward, Richard, *Thurgarton Priory, Southwell, Notts.*
1839	Portman, Viscount, *Bryanston, Blandford, Dorset.*
1856	Powis, Earl of, *Powis Castle, Welshpool, Montgomeryshire.*
1858	Rutland, Duke of, K.G., *Belvoir Castle, Grantham, Leicestershire.*
1839	Thompson, Harry Stephen, *Kirby Hall, York.*
1839	Tredegar, Lord, *Tredegar Park, Newport, Monmouthshire.*

Vice-Presidents.

1861	Cathcart, Earl, *Thornton-le-Street, Thirsk, Yorkshire.*
1839	Chichester, Earl of, *Stanmer Park, Lewes, Sussex.*
1867	Devonshire, Duke of, K.G., *Holker Hall, Lancashire.*
1847	Egmont, Earl of, *Cowdray Park, Petworth, Sussex.*
1847	Eversley, Viscount, *Heckfield Place, Winchfield, Hants.*
1848	Gibbs, B. T. Brandreth, *Halfmoon Street, Piccadilly, London,* W.
1847	Hill, Viscount, *Hawkstone Park, Salop.*
1858	Kerrison, Sir Edward C., Bart., *Brome Hall, Scole, Suffolk.*
1839	Miles, Sir William, Bart., *Leigh Court, Bristol, Somersetshire.*
1852	Richmond, Duke of, K.G., *Goodwood, Chichester, Sussex.*
1859	Vernon, Lord, *Sudbury Hall, Derby.*
1855	Wynn, Sir Watkin Williams, Bt., M.P., *Wynnstay, Ruabon, Denbighshire.*

Other Members of Council.

1855	Acland, Sir Thomas Dyke, Bart., M.P., *Sprydoncote, Exeter, Devonshire.*
1858	Amos, Charles Edwards, 5, *Cedars Road, Clapham Common, Surrey.*
1848	Barnett, Charles, *Stratton Park, Biggleswade, Bedfordshire.*
1853	Barthropp, Nathaniel George, *Hacheston, Wickham Market, Suffolk.*
1873	Bedford, Duke of, *Woburn Abbey, Bedfordshire.*
1868	Booth, Thomas Christopher, *Warlaby, Northallerton, Yorkshire.*
1863	Bowly, Edward, *Siddington House, Cirencester, Gloucestershire.*
1861	Cantrell, Charles S., *Riding Court, Datchet, Bucks.*
1872	Chaplin, Henry, M.P., *Blankney Hall, Lincoln.*
1866	Davies, David Reynolds, *Agden Hall, Lymm, Cheshire.*
1861	Dent, J. D., M.P., *Ribston Hall, Wetherby, Yorkshire.*
1860	Druce, Joseph, *Eynsham, Oxford.*

Year when Elected.	
1868	Edmonds, William John, *Southrope, Lechlade, Gloucestershire.*
1871	Egerton, Hon. Wilbraham, M.P., *Rostherne Manor, Knutsford, Cheshire.*
1873	Evans, John, *Uffington, Shrewsbury, Salop.*
1872	Exeter, Marquis of, K.G., *Burghley House, Stamford, Lincolnshire.*
1866	Hornsby, Richard, *Spittle Gate, Grantham, Lincolnshire.*
1854	Hoskyns, Chandos Wren, M.P., *Harewood, Ross, Herefordshire.*
1871	Jones, J. Bowen, *Ensdon House, Shrewsbury, Salop.*
1863	Kingscote, Colonel, M.P., *Kingscote, Wootton-under-Edge, Gloucestershire.*
1848	Lawes, John Bennet, *Rothamsted, St. Albans, Herts.*
1869	Leeds, Robert, *Wicken Farm, Castleacre, Brandon, Norfolk.*
1872	Leicester, Earl of, K.G., *Holkham Hall, Wells, Norfolk.*
1868	Lichfield, Earl of, *Shugborough, Staffordshire.*
1867	Liddell, Hon. Henry George, M.P., *Ravensworth Castle, Durham.*
1865	Lopes, Sir Massey, Bart., M.P., *Maristow, Roborough, Devon.*
1871	McIntosh, David, *Havering Park, Romford, Essex.*
1871	Masfen, R. Hanbury, *Pendeford, Wolverhampton, Staffordshire.*
1857	Pain, Thomas, *The Grove, Basingstoke, Hants.*
1861	Randell, Charles, *Chadbury, Evesham, Worcestershire.*
1868	Ransome, Robert Charles, *Ipswich, Suffolk.*
1871	Rawlence, James, *Bulbridge, Wilton, Salisbury, Wilts.*
1869	Ridley, M. White, M.P., *Blagdon, Cramlington, Northumberland.*
1861	Rigden, William, *Hove, Brighton, Sussex.*
1856	Shuttleworth, Joseph, *Hartsholme Hall, Lincoln.*
1872	Skelmersdale, Lord, *Lathom Hall, Ormskirk, Lancashire.*
1869	Statter, Thomas, *Stand Hill, Whitefield, Manchester, Lancashire.*
1873	Torr, John, M.P., *Carlett Park, Eastham, Chester.*
1857	Torr, William, *Aylesby Manor, Great Grimsby, Lincolnshire.*
1845	Turner, George, *Brampford Speke, Exeter, Devonshire.*
1871	Turner, Jabez, *Haddon, Huntingdonshire.*
1871	Wakefield, William H., *Kendal, Westmoreland.*
1867	Webb, James, *Spring Hill, Fladbury, Pershore, Worcestershire.*
1870	Welby, William Earle, M.P., *Newton House, Folkingham, Lincolnshire.*
1871	Wells, John, *Booth Ferry, Howden, Yorkshire.*
1861	Wells, William, M.P., *Holmewood, Peterborough, Northamptonshire.*
1870	Whitehead, Charles, *Barming House, Maidstone, Kent.*
1866	Wilson, Lieut.-Colonel Fuller Maitland, *Stowlangtoft Hall, Bury St. Edmund's, Suffolk.*
1865	Wilson, Jacob, *Woodhorn Manor, Morpeth, Northumberland.*

Secretary and Editor.

H. M. JENKINS, 12, *Hanover Square, London*, W.

Consulting Chemist—Dr. Augustus Voelcker, F.R.S., 11, *Salisbury Square*, E.C.
Consulting Botanist—W. Carruthers, F.R.S., F.L.S., *British Museum*, W.C.
Consulting Veterinary Surgeon — James Beart Simonds, *Royal Veterinary College*, N.W.
Consulting Engineers—Eastons & Anderson, *The Grove, Southwark Street*, S.E.
Seedsmen—Thomas Gibbs and Co., *Corner of Halfmoon Street, Piccadilly*, W.
Publisher—John Murray, 50, *Albemarle Street*, W.
Bankers—The London and Westminster Bank, *St. James's Square Branch*, S.W.

STANDING COMMITTEES FOR 1873.

Finance Committee.

Bridport, Viscount, Chairman.
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Kingscote, Colonel, M.P.
Randell, Charles.
Torr, William.

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The President.
Chairman of Finance Committee.
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Dent, J. D., M.P.
Druce, Joseph.
Gibbs, B. T. Brandreth.
Leeds, Robert.
Masfen, R. H.
Milward, Richard.
Randell, Charles.
Ridley, M. White, M.P.
Rigden, William.
Torr, William.
Turner, George.
Wakefield, W. H.
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Implement Committee.

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VERNON, Lord.
AMOS, C. E.
CANTRELL, CHAS. S.
DRUCE, JOSEPH.
EDMONDS, W. J.
GIBBS, B. T. BRANDRETH.
HORNSBY, RICHARD.
HOSKYNS, C. WREN, M.P.
JONES, J. BOWEN.
LEEDS, ROBERT.
MASFEN, R. H.
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RANSOME, R. C.
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THOMPSON, H. S.
TORR, WILLIAM.
WAKEFIELD, W. H.
WELBY, W. EARLE, M.P.
WELLS, JOHN.
WHITEHEAD, CHARLES.
WILSON, JACOB.
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BEDFORD, Duke of.
POWIS, Earl of.
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CHESHAM, Lord.
KESTEVEN, Lord.
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BOOTH, T. C.
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DRUCE, JOSEPH.
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HORNSBY, RICHARD.
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MILWARD, RICHARD.
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SHARMAN, MARK.
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TORR, WILLIAM.
TRETHEWY, H.
TURNER, JABEZ.
WAKEFIELD, W. H.
WEBB, JAMES.
WELLS, WILLIAM, M.P.
WHITEHEAD, CHARLES.
WILSON, JACOB.

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BRIDPORT, Viscount.
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AMOS, C. E.
BOOTH, T. C.
GIBBS, B. T. BRANDRETH.
HORNSBY, RICHARD.
MILWARD, RICHARD.
SHUTTLEWORTH, JOSEPH.
TORR, WILLIAM.
WELLS, JOHN.
WILSON, JACOB.

Committee of Selection.

BRIDPORT, Viscount.
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DENT, J. D., M.P.
GIBBS, B. T. BRANDRETH.
HOLLAND, E.
KINGSCOTE, Colonel, M.P.
MILWARD, R.
RANDELL, CHARLES.
THOMPSON, H. S.
TORR, WILLIAM.
WELLS, WILLIAM, M.P.

And the Chairmen of the Standing Committees.

Education Committee.

HOLLAND, E. (Chairman).
LICHFIELD, Earl of.
POWIS, Earl of.
ACLAND, Sir T. DYKE, Bart., M.P.
DENT, J. D., M.P.
JONES, J. BOWEN.
KINGSCOTE, Colonel, M.P.
RANSOME, R. C.
WELLS, WILLIAM, M.P.
VOELCKER, Dr.
WHITEHEAD, CHARLES.

Cattle Plague Committee.

THE WHOLE COUNCIL.

*** The PRESIDENT, TRUSTEES, and VICE-PRESIDENTS are Members *ex officio* of all Committees.

Royal Agricultural Society of England.

GENERAL MEETING,

12, Hanover Square, Thursday, May 22nd, 1873.

REPORT OF THE COUNCIL.

During the past half-year 4 Governors and 71 Members have died, and the names of 151 Members have been removed from the list by resignation, or by Order of the Council; but, on the other hand, 197 Members have been elected, so that the Society now consists of

74 Life Governors,
62 Annual Governors,
1832 Life Members,
3936 Annual Members,
12 Honorary Members,

making a total of 5916, and showing an increase of 150 Members since the Annual Meeting last May.

The Council have published in the last number of the Journal a list of Members of the Society classified into counties, and, in accordance with the suggestion made at the last General Meeting, have issued with it a form of nomination for Members of the Society. The Council are glad to report that the facilities thus afforded have been utilised to a satisfactory extent, and they hope that the list will be still further enlarged by the individual exertions of Members in their respective districts.

The accounts for the year 1872 have been examined and certified by the auditors and accountants of the Society, and have been published in the last number of the Journal, together with the statement of receipts and expenditure connected with the Country Meeting at Cardiff. The funded capital of the Society remains the same as at the last half-yearly meeting, namely, 24,112*l.* 7*s.* 8*d.* New Three per Cents. In addition, the following sums are available for defraying the expenses of the forthcoming Country Meeting, to be held at Hull, namely, an amount of 2000*l.* which lies on deposit with the Society's bankers, and the balance of the current account, which on the 1st instant amounted to 2911*l.* 13*s.* 7*d.*

The Council regret to report that during the past half-year the Society has lost one of its most distinguished members by the death of Lord Ossington. The vacancy thus caused in the list of Trustees has been filled by the election of Lord Kesteven. Mr. N. C. Stone having resigned his seat as a Member of the Council, the vacancy thus created has been filled by the election of Mr. J. Evans, of Uffington, Shropshire.

The Hull Local Committee and the Agricultural Associations of the East Riding of Yorkshire are co-operating with the Council to promote the success of the ensuing Country Meeting, and have added to the Society's Prize-list, Prizes for Hunters, Hackneys, and Agricultural Horses. The list has been still further augmented by the Hull butchers, who have offered Prizes for Dairy Cattle, Steers, and Wether Sheep, and by Mr. Pease, of Darlington, who has devoted 100*l.* to Prizes for Asses and Mules for agricultural purposes.

In compliance with a general wish expressed at the last half-yearly meeting, the Council have decided to offer at the Hull Meeting a Prize of 25*l.* for the best combined Stacking Machine, although hay and straw elevators were submitted to trial at Cardiff. The competing machines will be tried with sheaf-corn, hay, and loose corn and straw; they will be worked by horse-power, but must also be adapted for use in conjunction with a steam threshing machine if required.

The Council regret that only one Wold farm and four Holderness farms were entered to compete for the prizes of 100*l.* each, offered for the best-managed farm in the Holderness and Wold districts of the East Riding of Yorkshire respectively. One of the conditions of competition was that there must be at least six competitors in each class, unless the Council should otherwise specially determine; the prize for the Yorkshire Wold farm has therefore been withdrawn, but the offer of the prize for the Holderness farm has been maintained. As on previous occasions, the award of this prize will be announced at the General Meeting held in the Show-yard.

The constantly increasing difficulty and expense of submitting to a thorough trial the whole range of agricultural implements in the course of five years has recently received the careful consideration of the Council. After obtaining the opinions of the leading manufacturers of agricultural implements, the Council have decided to divide the implements placed for trial in the last year of the existing quinquennial rotation into two groups, one to be tried in 1873 and the remainder in 1874. They have further arranged a rotation of implements for trial, to extend over nine years. By this means they believe they will maintain the high standard which the Society's trials now possess as a test of merit; and the rule which enables the Stewards to submit to trial any implement whose principle is manifestly new, will insure that the comparatively long period of nine years between the trials of the same class of implements shall be no impediment to the introduction and use of valuable improvements in agricultural machinery.

The following is the rotation of implements for trial in 1873 and following years as at present arranged:—

1873.—Horse-power Machines and Implements used in Tillage.

Ploughs.	Harrows.
Scarifiers.	Cultivators.
Rollers.	Clodcrushers.
Digging Machines.	

1874.—Machines and Implements used in the cultivation and carrying of crops.

Drills.	Horse-hoes.
Root-thinners.	Carts.
Waggons.	Manure-distributors.
Liquid-manure carts.	

1875.—Machines and Implements used in the harvesting of grass crops.

Mowing Machines.	Haymakers.
Horse-rakes.	Hay collectors.
Hay elevators.	

1876.—Machines and Implements used in the harvesting of grain and root crops.

Reaping Machines.	Sheaf binders.
Potato and Root-raisers.	Elevators for stacking corn.

1877.—Machines and Implements used in the preparation of food, and in the feeding of Stock.

Mills.	Oilcake-breakers.
Chaff cutters.	Turnip cutters.
Root pulpers.	Steaming apparatus.
Feeding appliances.	Horse gears.

1878.—Steam-power Machinery used in Tillage.

Engines with winding apparatus or windlasses.	Rope-porters, &c.
Ploughs.	Ridging Implements.
Cultivators.	Diggers.
Pulverizers.	Clodcrushers.
Harrows.	Anchors.

1879.—Machines and Implements used in the preparation of crops for market.

Threshing machines.	Straw elevators.
Dressing machines.	Separators.
Barley hummellers.	Seed Shellers.
Flax machinery.	Hay presses.
Corn dryers.	Trussing machines.

1880.—Machines and Implements used in Drainage, Roadmaking, Building, General Estate Work, Forestry, and Dairy Work.

Draining machines.	Tile and brick machines.
Stone breakers.	Stone and root extractors.
Bone mills.	Road rollers.
Gates, fencing, stiles, &c.	Dairy implements.
Hop machinery.	Thatch-making machines.

1881.—Steam Engines.

Portable engines.	Agricultural Locomotives.
Waggons suitable for ditto.	

In connection with the Society's practice of offering prizes for the best agricultural implements, and of submitting to trial those entered to compete for the prizes offered, as well as others selected by the Judges from those exhibited in the Show-yard, the following resolution was passed at a meeting of manufacturers of agricultural implements held last February:—

'That, in the opinion of this meeting, considering the increased difficulty of conducting competitive trials at the time of the annual Show, this meeting would urge upon the Council the desirability of considering if the object sought could not be better accomplished by abandoning the present system of awarding prizes, and adopting instead thereof a thorough trial at a suitable season of the year for the various implements and machines, and the publication of a full and accurate report of the performance of each.'

This resolution having been submitted to the Council and duly considered, it was resolved that the Society, having recently revised the conditions of competition in order to give a more thorough trial to every class of implements, decline acceding to the request of the implement-makers that the competitive and prize system should be abandoned.

The Council have also to report that in consequence of the increased work connected with the awards of prizes at the Country Meetings, they have deemed it expedient to appoint four Stewards of the Show-yard in the departments of Stock and of Implements respectively, instead of three as heretofore.

The district assigned for the Country Meeting in 1874 comprises the counties of Bedford, Cambridge, Essex, Hertford, Huntingdon, Norfolk, and Suffolk. Invitations were received from the authorities of Bedford, Cambridge, and Norwich, and the sites and other accommodation offered were inspected by a Committee of the Council specially appointed for the purpose. After duly considering the report of this Committee, the Council have decided that the Country Meeting for 1874 shall be held at Bedford. The Council have also to announce that the Country Meeting for 1875 will be held in the district comprising the counties of Cornwall, Devon, Dorset, Somerset, and Wilts.

The Council have deputed Professor Wrightson, of the Royal Agricultural College, Cirencester, to proceed to Vienna, and prepare a report for publication in the Society's Journal on the agricultural department of the Vienna Universal Exhibition, and on some of the most remarkable features of the farming of the Austro-Hungarian Empire.

The recent appointment of a Select Committee of the House of Commons to enquire into the working of the Contagious Diseases (Animals) Act has been a matter of congratulation to the Council as well as to the agricultural public generally, and the Secretary of the Society has been authorised to attend on behalf of the Society, and give evidence before that Committee, especially with reference to the investigation into the Trade in Animals which he conducted last autumn, and an account of which has been published in the last number of the Journal.

The Educational Examinations were held at the Society's Rooms, on Tuesday, April 22nd, and four following days. Of the twelve candidates who entered, nine presented themselves for examination, all of them having been students at the Royal Agricultural College, Cirencester. Messrs. Leyson, Kennedy, and North were the three successful candidates, and each obtained a first-class certificate, consequently becoming a life-member of the Society. In addition, Mr. Leyson gained a prize of 25*l.*, Mr. Kennedy one of 10*l.*, and Mr. North one of 5*l.*

By order of the Council,

H. M. Jenkins,

Secretary.

ROYAL AGRICULTURAL

DR. HALF-YEARLY CASH ACCOUNT

	£ s. d.	£ s. d.	£ s. d.
To Balance in hand, 1st January, 1873:—			
Bankers		411 10 10	
Secretary		80 5 8	
			491 16 6
To Income:—			
Dividends on Stock		355 13 2	
Subscriptions:—			
Governor's Life-Composition	40 0 0		
Governors' Annual	265 0 0		
Members' Life-Compositions	711 0 0		
Members' Annual	2932 0 0		
		3,948 0 0	
Journal:—			
Sales of Pamphlets		23 10 0	
Sundries:—			
Donations on account of Law Costs in the case of Kidd *v.* the Society		110 0 0	
Farm Inspection:—Entry Fees		11 0 0	
Cardiff Meeting		15 1 6	
Total Income		4,463 4 8	
To Hull Meeting		5,017 17 9	
			9,481 2 5
			£9,972 18 11

BALANCE-SHEET,

LIABILITIES.	£ s. d.	£ s. d.	£ s. d.
To Capital:—			
Surplus, 31st December, 1872		27,719 14 2	
Surplus of Income over Expenditure during the Half-year, viz.:—			
Income	4,463 4 8		
Expenditure	2,921 16 9		
		1,541 7 11	
			29,261 2 1
Less half-year's interest and depreciation on Country Meeting Plant		.. .. ..	195 19 9
			£29,065 2 4

BRIDPORT, *Chairman of Finance Committee.*
QUILTER, BALL, & Co., *Accountants.*

SOCIETY OF ENGLAND.

FROM 1ST JANUARY TO 30TH JUNE, 1873. Cr.

	£ s. d.	£ s. d.	£ s. d.
By Expenditure :—			
Establishment :—			
Salaries, Wages, &c.	532 6 0		
House :—Rent, Taxes, Repairs, &c.	279 13 8		
Office :—Printing, Postage, Stationery, &c. ..	201 6 9		
		1,013 6 5	
Journal :—			
Printing and Stitching	486 2 6		
Postage and Delivery	129 10 0		
Literary Contributions	20 10 0		
Woodcuts and Lithographs	36 13 6		
Printing Pamphlets	7 16 6		
Wrappers for 4 Deliveries	33 10 0		
Miscellaneous	7 0 0		
		721 2 6	
Professor Wrightson on account of Journey to Vienna		150 0 0	
Chemical :—			
Consulting Chemist's Salary	150 0 0		
Grant for Investigations	200 0 0		
		350 0 0	
Veterinary :—			
Grant to Royal Veterinary College (half year) to Christmas, 1872		75 0 0	
Botanical :—			
Consulting Botanist's Salary		50 0 0	
Education		90 6 6	
Subscriptions (paid in error) returned		13 1 0	
Sundries :—			
Law Charges	308 13 9		
Expenses of Inspection Committee	34 14 1		
		343 7 10	
Farm Inspection :—Advertising, &c.		33 12 6	
Cardiff Meeting		82 0 0	
Total Expenditure		.. .. ..	2,921 16 9
By Hull Meeting		.. .. ..	3,604 10 0
			6,526 6 9
By Balance in hand, 30th June :—			
Bankers	1,414 9 5		
Secretary	32 2 9		
		1,446 12 2	
At Deposit with London and Westminster Bank		2,000 0 0	
			3,446 12 2
			£9,972 18 11

30TH JUNE, 1873.

ASSETS.	£ s. d.	£ s. d.
By Cash in hand	1,446 12 2	
By Deposit Account	2,000 0 0	
By New 3 per Cent. Stock 24,112*l*. 7*s*. 8*d*. cost*	22,920 7 1	
By Books and Furniture in Society's House	1,451 17 6	
By Country Meeting Plant	2,417 16 8	
		30,236 13 5
Less at Credit of Hull Meeting	.. .. ..	1,171 11 1
* *Value at* 92½ = £22,302 4*s*. 4½*d*.		
Mem.—The above Assets are exclusive of the amount recoverable in respect of arrears of Subscription to 30th June, 1873, which at that date amounted to 858*l*.		
		£29,065 2 4

Examined, audited, and found correct, this 25th day of August, 1873.

A. H. JOHNSON,
FRANCIS SHERBORN,
HENRY CANTRELL, } *Auditors on behalf of the Society.*

SHOW AT HULL,

JULY, 1873.

STEWARDS OF THE YARD.

Stock.

Richard Milward,
Robert Leeds,
M. White Ridley, M.P.,
William H. Wakefield.

Implements.

William J. Edmonds,
Thomas C. Booth,
Charles Whitehead,
Jabez Turner.

Forage.

Joseph Tiffen.

Honorary Director.

B. T. Brandreth Gibbs.

JUDGES OF STOCK.

HORSES.

N. G. Barthropp,
R. Swale,
Alexander Turnbull,
H. D. Boulton,
Colonel Luttrell,
John Usher.

ASSES AND MULES.

S. Lang,
Professor J. A. McBride.

CATTLE.

Shorthorns and Cattle of any Breed.

H. W. Beauford,
R. Jefferson,
A. Mitchell.

Herefords and Devons.

R. Greenslade,
H. Haywood,
H. W. Keary.

Jerseys, Guernseys, Galloways, Ayrshires and other Established Breeds.

Thomas Gibbons,
Henry Middleton,
Henry Tait.

SHEEP.

Leicesters and Longwools of any Breed.

Charles Clarke,
Thomas Potter,
William Sanday.

Cotswolds and Oxfordshire Downs.

Hugh Aylmer,
Robert Garne,
R. J. Newton.

Lincolns and Sheep of any Breed.

J. H. Casswell,
J. Greetham,
R. G. F. Howard.

Border Leicesters, Cheviots, Blackfaced and Mountain Sheep.

J. Jardine,
George Rea,
James T. Rand.

Southdowns and Hampshires.

Henry Fookes,
Henry P. Hart,
T. Chapman Saunders.

Shropshires.

Thomas Horley, Jun.,
R. H. Masfen,
Charles Randell.

PIGS.

Edward Little,
John Lynn,
J. S. Turner.

Inspectors of Shearing.

HENRY BONE, ROBERT BROWN, WILLIAM JOBSON.

Veterinary Inspectors.

PROFESSOR BROWN, R. L. HUNT.

JUDGES OF IMPLEMENTS.

Section I.—Ploughs (Subsections A and B), and Miscellaneous Articles.

JOHN HICKEN,
J. D. OGILVIE,
T. P. OUTHWAITE.

Section I.—Ploughs (Subsections C to K).

MAJOR GRANTHAM,
JOHN HEMSLEY,
J. W. KIMBER.

Sections II. III. and IV.—Harrows, Rollers and Clod-Crushers, Cultivators, and Scarifiers.

S. ROWLANDSON,
J. STEPHENSON,
EDWARD WORTLEY.

Combined Stacking Machines.

HENRY CANTRELL,
C. G. ROBERTS,
MATTHEW SAVIDGE.

Reporter.—JOHN COLEMAN.

Farm Judges.

R. H. PEARSON, HUGH STEPHENSON, JOHN THOMPSON.

AWARD OF PRIZES.

NOTE.—The Judges were instructed, besides awarding the Prizes, to designate as the *Reserve Number* one animal in each Class, next in order of merit, if it possessed sufficient for a Prize—in case an animal to which a Prize was awarded should subsequently become disqualified.

HORSES.

Agricultural Stallions foaled before the 1*st of January,* 1871.

COATES SHARPLEY, Kelstone Hall, Louth, Lincolnshire: FIRST PRIZE, 25*l.*, for "Le Bon," bay, 5 years old; bred by Mr. Fullard, Thorney, Peterborough; sire, "Wonder;" sire of dam, "Thumper."

THOMAS STATTER, Stand Hall, Whitefield, Manchester: SECOND PRIZE, 15*l.*, for "Young Champion," chestnut, 6 years-old; bred by Mr. Stokes, Caldecot, Rockingham; sire, Mr. Stokes's "Champion."

THOMAS GREENWOOD, Culverley Bridge, Rodley, Leeds: THIRD PRIZE, 5*l.*, for "Young Honest Tom," bay, 4 years-old; bred by Mr. Jonas Few, Willingham, St. Ives.

RICHARD MARSHALL, Keyingham, Hull: the *Reserve Number*, to "Simon Pure," brown, 5 years-old; bred by Mr. C. Lister, Saleby, Alford.

Agricultural Stallions—Two Years old.

HENRY NEWMAN, Friars' Court, Clanfield, Faringdon, Berks: FIRST PRIZE, 20*l.*, for "Young Briton," blue roan; bred by himself; dam, "Flower."

JOHN LINTON, Westwick Hall, Cambridge: SECOND PRIZE 10*l.*, for "King Tom," bay; bred by Mr. Wayman, Wallingham, Cambs.

MATTHEW THOMLINSON, Cowthorpe, Wetherby, Yorkshire: THIRD PRIZE, 5*l.*, for "Brown Prince," brown; bred by himself; sire, "Lincolnshire;" dam, "Darling;" sire of dam, "Royal Conqueror."

THOMAS BOOT COLTON, Eagle Hall, Newark-on-Trent: the *Reserve Number*, to "Boxer," chestnut; bred by Mr. W. Toder, West Burton, Lincoln; sire, "Bold Lincoln."

Clydesdale Stallions foaled before the 1*st January,* 1871.

ROBERT ORANGE, Bedlington, Morpeth, Northumberland: FIRST PRIZE, 25*l.*, for "Conqueror," dark grey, 7 years-old; bred by the late Mr. J. Lilburn, Preston, North Shields; sire, "Young Glanoer;" dam, "Beauty;" sire of dam, "Young Conqueror."

EDWARD AND ALFRED STANFORD, Eatons, Ashurst, Steyning, Sussex: SECOND PRIZE, 15*l.*, for "The Duke," 6 years-old; bred by the Duke of Hamilton; sire, "Sir Walter Scott;" dam, "Bell;" sire of dam, "Lothian Tom."

MATTHEW REED, Beamish Burn, Chester-le-Street, Durham: THIRD PRIZE, 5*l.*, for "Wellington," brown, 7 years-old; bred by Mr. H. Largs; sire, "Surprise."

THOMAS TAGG, Newhall, Burton-on-Trent, Staffordshire, the *Reserve Number*, to "Young Lofty," bay, 12 years-old; bred by Mr. J. Clark, Mansurac, Kilbarchan, N.B.

Clydesdale Stallions—Two Years old.

THE EARL OF STRATHMORE, Glamis Castle, Forfar, N.B.: FIRST PRIZE, 20*l.*, for "Macbeth," bay; bred by Mr. J. Rankine, Culhorne, Stranraer, N.B.; sire, "Lord Lyon."

THE DUKE OF RICHMOND, K.G., Goodwood, Chichester, Sussex: SECOND PRIZE, 10*l.*, for "Duke," bay; bred by Mrs. Watson, Nisbet, Biggar, N.B.; sire, "Farmer's Fancy;" dam, "Jean."

CUTHBERT YOUNG WRIGHT, Drumleaning, Wigton, Cumberland: THIRD PRIZE: 5*l.*, for "Sir Roger," brown; bred by himself; sire, "Clydesdale Tom;" dam, "Bonny;" sire of dam, "Blythe."

DAVID RIDDELL, Kilhowie, Duntocher, N.B.; the *Reserve Number*, to his bay; breeder unknown.

Suffolk Stallions foaled before the 1*st of January*, 1871.

LIEUT-COLONEL FULLER MAITLAND WILSON, Stowlangtoft Hall, Bury St. Edmund's, Suffolk: FIRST PRIZE, 25*l.*, for "Heir Apparent," chestnut, 4 years-old; bred by Mr. S. Wolton, Newbourne Hall, Woodbridge; sire, "Monarch;" dam, "Victoria."

SAMUEL WOLTON, Butley Abbey, Wickham Market, Suffolk: SECOND PRIZE, 15*l.*, for "Royal Duke 2nd," chestnut, 3 years-old; bred by himself; sire, "Magnum Bonum;" dam, "Royal Moggy;" sire of dam, "Royal Duke."

WILLIAM BYFORD, The Court, Glemsford, Suffolk: THIRD PRIZE, 5*l.*, for "Volunteer," chestnut, 5 years-old; bred by Mr. L. Wrench, Birch Hall, Walton, Essex; sire, Wolton's "Warrior;" sire of dam, Catlin's "Duke."

BENJAMIN HEYWOOD BROOKSBANK, Tickhill, Rotherham, Yorkshire, the *Reserve Number*, to "Royal Prince," chestnut, 7 years-old: bred by Mr. C. Frost, Wherstead, Ipswich; sire, "Conqueror;" dam, "Bonny."

Suffolk Stallions—Two Years old.

SAMUEL WOLTON, Butley Abbey, Wickham Market: FIRST PRIZE, 20*l.*, for his chestnut; bred by Mr. Horace Wolton, Newbourn Hall, Woodbridge; sire, "Magnum Bonum;" dam, "Duchess;" sire of dam, "Warrior."

Thoroughbred Stallions suitable for getting Hunters.

HENRY CHAPLIN, M.P., Blankney Hall, Lincoln: FIRST PRIZE, 50*l.*, for "Dalesman," chestnut, 10 years-old; bred by Baron de Rothschild, Mentmore, Leighton Buzzard; sire, "King Tom;" dam, "Agnes;" sire of dam, "Pantaloon."

WILLIAM TAYLOR SHARPE, Baumber Park, Horncastle, Lincolnshire: SECOND PRIZE, 25*l.*, for "Suffolk;" brown, 8 years-old; bred by Baron M. de Rothschild, Mentmore; sire, "North Lincoln;" dam, "Protection;" sire of dam, "Defence."

Major F. Barlow, Hasketon, Woodbridge, Suffolk: Third Prize, 10*l.*, for "Chaucer," chestnut, 5 years-old; bred by Mr. G. Payne, Newmarket; sire, "Cambuscan;" dam, "Plush;" sire of dam, "Plenipotentiary."

Major F. Barlow, Hasketon, the *Reserve Number*, to "Massanissa," brown, 7 years-old; bred by M. Lupin, in France; sire, the "Flying Dutchman;" dam, "Calpurnia;" sire of dam, "Ion."

Stallions above 14 *hands, but not exceeding* 15 *hands* 2 *inches, suitable for getting Hackneys.*

Robert Cowton, Great Kelk, Lowthorpe, Hull: First Prize, 20*l.*, for "Lord Stanley," dark brown, 3 years-old: bred by Mr. M. Harrison, Warter, Pocklington; sire, "Sir Charles;" dam, "Fanny."

John Charles Leake, Low Drewton, South Cave, Brough, Yorkshire: Second Prize, 10*l.*, for "Young Lord Derby," chestnut, 3 years-old; bred by himself; sire, "Lord Derby;" dam, "Miss Kitty;" sire of dam, "Telegraph."

Henry Richard Wood Hart, Dunnington Lodge, Dunnington, Yorkshire: Third Prize, 5*l.*, for "All Fours," bay, 18 years-old; bred by himself; sire, "Prickwillow;" dam, "Maid of All Work; sire of dam, "Old Fireaway."

Philip Triffit, Millington, Pocklington, Yorkshire: the *Reserve Number*, to "Fireaway," brown, 14 years-old; bred by himself; sire, "Achilles;" dam, "Nance."

Pony Stallions not exceeding 14 *hands.*

Christopher W. Wilson, High Park, Kendal: First Prize, 15*l.*, for "Sir George," brown, 5 years-old; bred by Mr. W. Walker, Shadwell; sire, "Sportsman."

Edward Henry Marfleet, Bassingham, Newark, Notts: Second Prize, 10*l.*, for "Mischief," dark brown, 3 years-old; bred by Mr. C. B. Marfleet, Bassingham; sire, "Red Cross Knight;" sire of dam, "Tom Tit."

James Moffat, Kirklinton Park, Carlisle; the *Reserve Number*, to "Robbie Burns," dark brown, 3 years-old; breeder unknown.

Agricultural Mares, in foal or with foal at foot.

Edmund Crowe, Denver, Downham Market, Norfolk: First Prize, 20*l.*, for "Flower," chestnut, 3 years-old (in foal to Mr. Ingledew's "Honest Tom"): bred by himself: sire, Mr. Wincarl's "Young England's Glory;" dam, "Smart;" sire of dam, Mr. Dack's "Matchless."

Frederick Street, Harrowden House, Bedford: Second Prize, 10*l.*, for "Beauty," roan, 7 years-old (in foal to Mr. Waltham's "Young Honest Tom"); bred by Mr. Granger, Haddenham, Ely; sire of dam, Tibbet's "Thumper."

Charles Lister, Coleby Lodge, Lincoln: Third Prize, 5*l.*, for "Royal Duchess;" bay, six years old (in foal); bred by himself; sire, "Champion the Third;" dam, "Diamond."

John Appleyard, Wistow, Selby, Yorkshire, the *Reserve Number*, to "Jewel;" grey, 7 years-old (and foal by "Oxford"); bred by himself; sire, "John Bull;" dam, "Violet;" sire of dam, "Protection."

Clydesdale Mares, in foal or with foal at foot.

ROBINSON WATSON, Maltby House, Stockton-on-Tees: FIRST PRIZE, 20*l.*, for "Highland Lassie;" bay, 8 years-old (and foal by "Wellington); bred by Mr. L. Drew, Merryton, N.B.; sire, "Sir Walter Scott."

JAMES NICOL FLEMING, Knockdon, Maybole, Ayrshire: SECOND PRIZE, 10*l.*, for "Rosie;" brown; 3 years-old (in foal to "Prince Arthur"); bred by himself; sire, "Prince of Wales;" dam, "Rosie;" sire of dam, "Easter-hill."

THOMAS STATTER, Stand Hall, Whitefield, Manchester: THIRD PRIZE, 5*l.*, for "Mrs. Muir;" bay, 7 years-old (and foal by "Black Prince"), bred by Mr. Muir, Loch Fergus, Kirkcudbright; sire, "Champion."

The EARL OF STRATHMORE, Glamis Castle, Forfar, N.B.: the *Reserve Number*, to "Rosie," bay, 5 years-old (in foal to "Clansman"); breeder unknown.

Suffolk Mares, in foal or with foal at foot.

HORACE WOLTON, Newbourne Hall, Woodbridge, Suffolk: FIRST PRIZE, 20*l.* for "Diamond," chestnut, 8 years-old; bred by Mr. S. Wolton, Newbourne Hall; sire, "Warrior;" dam, "Abbey;" sire of dam, Catlin's "Royal Duke."

Mares in foal or with foal at foot, suitable for breeding Hunters.

EDMUND HORNBY, Flotmanby, Ganton, Yorkshire: FIRST PRIZE, 25*l.*, for "Lady Derwent;" bay, 10 years-old (and foal by "Lozenge"); bred by Mr. Lambe; sire, "Codrington."

JOHN THOMAS ROBINSON, Leckby Palace, Asenby, Thirsk, Yorkshire: SECOND PRIZE, 15*l.*, for "Go-a-head," dark bay, 15 years-old (in foal to "Voltigeur"); breeder unknown; sire, "Sir William."

JOSEPH CLARKE, Highfield House, Beeston, Leeds: THIRD PRIZE, 5*l.*, for "Lady Byron," chestnut, 18 years-old (in foal); bred by Mr. J. Byron, Kirkby Green, Lincoln; sire, "Idle Boy."

JOHN FRANCIS LEIGHTON, Osgodby, Scarborough, the *Reserve Number*, to "Snowflake," bay, aged (and foal by "George Osbaldeston"); bred by Mr. Marris, Limber, Brigg; sire, "Magnum;" sire of dam, "Professor Buck."

Mares above 14 *hands, but not exceeding* 15 *hands* 1 *inch, suitable for breeding Hackneys.*

ROBERT WILLIAMSON, Sunny Bank, Ripon, Yorkshire: FIRST PRIZE, 20*l.*, for "Jessie," bay, 13 years-old (and foal by "Shepherd F. Knapp"); bred by himself: sire, "Elegant;" dam, "Maid of the Mill;" sire of dam, "Appleton Hero."

WILLIAM MAJOR, senior, Westway, Driffield, Yorkshire: SECOND PRIZE, 10*l.*, for "Polly," bay, 22 years-old (in foal to "St. Giles"); bred by himself; sire, "Sir Charles."

FRANCIS COOK, Thixendale, York: THIRD PRIZE, 5*l.*, for "British Queen," bay, 15 years-old (and foal by "President); bred by himself; sire, "British Champion;" dam, "Evening Star;" sire of dam, "Wildfire."

Thomas Edward Morrell, Hellaby Hall, Rotherham, Yorkshire; the *Reserve Number*, to "Miss Polly," bay, 6 years-old (in foal to "Strathconan"); bred by Mr. E. Morrell, Howden; sire, "Achilles;" sire of dam, "Performer."

Pony Mares not exceeding 14 hands.

John William Johnson, Riplingham Grange, Brough, Yorkshire: First Prize, 10*l.*, for "Venus," bay, 3 years-old; bred by Mr. Kirkpatrick, Straddlethorpe, Howden; sire, "Young Orville."

William Lawton Watson, 73, Mytongate, Hull: Second Prize, 5*l.*, for "Fairy," chestnut, 5 years-old; bred by Mr. W. Everingham, Withernwick, Hornsea; sire, "Young Merrylegs."

John Hope Barton, Stapleton Park, Pontefract, Yorkshire: the *Reserve Number*, to "Pit-a-Pat," bay, 3 years-old; bred by himself; sire, "The Brewer;" dam, "Peggy."

Agricultural Fillies—Two Years old.

John Appleyard, Wistow, Selby, Yorkshire: First Prize, 15*l.*, for his chestnut; bred by Mr. Williamson, Cliff, Selby; sire, "Oxford."

Edward and Alfred Stanford, Eatons, Steyning, Sussex: Second Prize, 10*l.*, for "Venture," brown; bred by themselves; sire, "Napoleon;" dam, "Diamond."

Edward Phillimore, Prestbury Park Farm, Cheltenham; the *Reserve Number*, to "Perfection;" red roan; bred by himself; sire, "Hartpury;" dam, "Flower;" sire of dam, "Thumper."

Clydesdale Fillies—Two Years old.

James Cunningham, Tarbroech, Dalbeattie, Kirkcudbright: First Prize, 15*l.*, for "Jean," bay; bred by Mr. Love, Scoupe Beith, Ayrshire; sire, "Clansman."

James Nicol Fleming, Knockdon, Maybole, Ayrshire: Second Prize, 10*l.*, for his bay; bred by Mr. Calder, Colgrain, Dumbartonshire: sire, "Prince of Wales."

James Graham, Parcelstown, Longtown, Cumberland: Third Prize, 5*l.*, for "Rose of Netherby," bay; bred by Mr. T. Johnston, Wattaman, Canonbie, Dumfries; sire, "Dundonald;" dam, "Meg;" sire of dam, "London Jock."

Suffolk Fillies—Two Years old.

William Wilson, Baylham Hall, Ipswich, Suffolk: First Prize, 15*l.*, for his chestnut; bred by himself; sire, "Breton;" dam, "Scott;" sire of dam, "Emperor."

William Wilson, Baylham Hall: Second Prize, 10*l.*, for his chestnut; bred by Mr. Frost, Wherstead, Ipswich; sire, "Young Pilgrim;" sire of dam, "Hero."

*Pairs of Agricultural Draught Horses.**

Charles William Brierley, Rhodes House, Middleton, Lancashire: the Prize of 20*l.*, for "Champion No. 1," bay, 7 years old, and "Tommy Dodd," bay, 5 years old; breeders unknown.

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* Given by the Holderness Agricultural Society.

*Hunters (Mares or Geldings), Five Years old and upwards.**

ROBERT BRUNTON, Marton, Middlesborough, Yorkshire: FIRST PRIZE, 15*l.*, and the CHAMPION PRIZE of 100*l.*,† for "Joe Beunett," bay gelding, 6 years old; bred by Mr. S. Atkinson, Low Beaumont Hill, Darlington; sire, "Hark Forward;" dam, "Lady Bennett;" sire of dam, "St. Bennett."

BOTTERELL HORNBY, Flotman-by-Ganton, Yorkshire: SECOND PRIZE, 10*l.*, for "Spellahoe," bay gelding, 6 years-old; bred by himself; sire, "Orpheus;" sire of dam, "Redshanks."

WILLIAM ARMSTRONG, Watts's Field, Kendal, Westmoreland; the *Reserve Number*, to "The Banker," bay gelding, 5 years-old; bred by Mr. W. H. Wakefield Sedgwick, Kendal; sire, "Best Returns;" sire of dam, "Muley."

Hunters (Mares or Geldings), Four Years-old, equal to carrying 14 stones over any hunting country.‡

JOHN GOODLIFF, George Hotel, Huntingdon: FIRST PRIZE, 35*l.*, aud the *Reserve Number* for the Champion Prize, for "Marshal MacMahon," chestnut gelding; bred by himself; sire, "General Hesse;" sire of dam, "Lancastrian."

JOHN M. TATTERSALL-MUSGRAVE, Beverley: SECOND PRIZE, 15*l.*, for "Honeycomb," chestnut gelding; bred by Mr. F. Shimmeris, Whitby; sire, "Angelus;" sire of dam, "Cato" or "Golden Forester."

CHARLES ROSE, Market Hill, Malton, the *Reserve Number*, to "Nobleman," bay gelding; breeder unknown; sire, "Pottinger;" dam, "Paulinus;" sire of dam, "Cowl."

Hunters (Mares or Geldings), Three Years-old.

BOTTERILL JOHNSON, Frodingham Bridge, Hull: FIRST PRIZE, 15*l.*, for "Showman," chestnut gelding;" bred by himself; sire, "Piccadore;" sire of dam, "Brutandorf."

MAJOR FREDERICK BARLOW, Hasketon, Woodbridge, Suffolk: SECOND PRIZE, 5*l.*, to "Cornishman," chestnut gelding; bred by Mr. James, Merthyr, Truro; sire, "Ballywood."

Hunters (Geldings), Two Years-old.‡

JOHN M. TATTERSALL-MUSGRAVE, Beverley: FIRST PRIZE, 15*l.*, for "Talisman," chestnut; bred by Mr. Jackson, Riston Grange, Beverley; sire, "Theobald;" sire of dam, "Galaor."

THOMAS HORROCKS MILLER, Singleton, Poulton-le-Fylde, Lancashire: SECOND PRIZE, 10*l.*, for "Victor," bay; bred by himself; sire, "Carbineer;" dam, "Lady Emily;" sire of dam, "Irish Birdcatcher."

LORD WENLOCK, Escrick Park, York: the *Reserve Number*, to his dark brown; bred by himself; sire, "Neptunus;" sire of dam, "Wild Hero."

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* Given by Driffield and the neighbourhood.
† Given by the Hull Local Committee.
‡ Given by Beverley and the neighbourhood.

Roadster Hackneys, from Four to Eight Years-old, and from 14 *hands* 2 *inches to* 15 *hands* 2 *inches high.**

Francis Cook Matthews, Easterfield House, Driffield: First Prize, 20*l.*, for "Ozone," brown mare, 5 years-old; bred by Mr. Fisher, Leconfield, Beverley; sire, "Fingal."

George Shadwick, Aikton, Wigton, Cumberland: Second Prize, 10*l.*, for "Polly," bay filly, 5 years-old; bred by himself; sire, "Motley;" dam, "Polly."

William Stephenson, Cottingham, Hull: the *Reserve Number*, to "Princess," chestnut mare, 5 years-old; bred by Mr. Vickerman, Swine, Hull; sire, "Young Charley;" sire of dam, "Phenomenon."

Jackasses not under 13 *hands, for getting Mules for Agricultural purposes.*†

Charles Leslie Sutherland, Coombe, Croydon, Surrey: First Prize, 25*l.*, for "Don Pedro II.," black, 7 years-old; bred by himself; Spanish sire; French dam.

Sir Henry Josias Stracey, Bart., Rackheath Park, Norwich: Second Prize, 15*l.*, for "Don Alphonso," grey, aged; breeder unknown (Spanish).

Mules under 15 *hands, for Agricultural purposes.*†

Charles Leslie Sutherland, Coombe, Croydon: First Prize, 25*l.*, for his grey, 5 years-old; breeder unknown; imported from Poitou, France.

Sir Henry Josias Stracey, Bart., Rackheath Park, Norwich: Second Prize, 15*l.*, for "Gipsy," brown, aged; breeder unknown.

Sir Henry Josias Stracey, Bart.: Third Prize, 10*l.*, for "Betty," brown, 3 years-old; bred by himself; sire, "Don Alphonso" (Spanish Donkey); dam, a carriage mare.

CATTLE.

Shorthorns—Bulls above Three Years old.

The Marquis of Exeter, Burghley Park, Stamford: First Prize, 30*l.*, for "Telemachus" (27,603), roan, 5 years, 2 months, 2 weeks, 4 days-old; bred by himself; sire, "Nestor" (24,648); dam, "Louisa 9th," by "Prince Albert" (18,579), g. d. "Louisa 7th," by "Baron Farnley" (14,129), gr. g. d. "Louisa 2nd" by "3rd Duke of York" (10,166).

William Linton, Sheriff Hutton, York: Second Prize, 20*l.*, for "Lord Irwin" (29,123), white, 4 years, 5 months, 1 week-old; bred by himself; sire, "British Hope" (21,324); dam, "Handmaid" by "May Day" (20,323); g. d. "White Rose" by "Magnus Troil" (14,880); gr. g. d. "Miss Henderson," by "Magnus Troil" (14,880).

George Garne, Churchill Heath, Chipping Norton, Oxfordshire: Third Prize, 15*l.*, for "3rd Earl of Warwickshire" (28,524), roan, 3 years, 7

* Given by Market Weighton and the neighbourhood.
† Given by Edward Pease, Esq., Darlington.

months, 3 weeks, 6 days-old; bred by Mr. H. J. Sheldon, Brailes House Shipston-on-Stour; sire, "Duke of Brailes" (23,724); dam, "Lady Emily 2nd," by "7th Duke of York" (17,754); g. d. "Lady Emily," by "Duke of Bolton" (12,738); gr. g. d. "Eugene," by "Grey Friar" (9172).

Major Henry Myles Stapylton, Myton Hall, Helperby, Yorkshire: Fourth Prize, 10*l.*, for "Colonist" (28,227), roan, 4 years, 5 months, 3 weeks, 3 days-old; bred by Lord Feversham, Duncombe Park, Helmsley; sire, "Orestes" (22,443); dam, "Columbia," by "Photograph" (20,492); g. d. "Charity," by "Sir Samuel" (15,302); gr. g. d. "Canary," by "Leonidas" (10,414).

Edgar Musgrove, West Tower, Aughton, Ormskirk, Lancashire: the *Reserve Number*, to "Royal Lancaster" (29,870), rich roan, 3 years, 1 week, 3 days-old; bred by Mr. D. R. Davies, Mere Old Hall, Knutsford; sire, "Grand Duke 10th" (21,848); dam, "Moss Rose," by "Marmaduke" (14,897); gr. d. "Cambridge Rose 6th," by "Third Duke of York" (13,166); gr. g. d. "Cambridge Rose 5th," by "2nd Cleveland Lad" (3408).

Shorthorns—Bulls above Two and not exceeding Three Years old.

Alexander Henry Browne, Bank House, Acklington, Northumberland: First Prize, 25*l.*, for "Duke of Aosta" (28,356), roan, 2 years, 7 months, 3 weeks, 6 days-old; bred by Mr. T. H. Hutchinson, Manor House, Catterick, sire, "K.C.B." (26,492); dam, "Queen of Spain," by "Valasco" (15,443); g. d. "Ciss," by "Young Hopewell" (14,719); gr. g. d. "Cicely,' by "Bellmont (11,164).

John Jervis Sharp, Broughton, Kettering, Northamptonshire: Second Prize, 15*l.*, for "Cambridge Duke 5th," roan, 2 years, 3 months, 2 weeks-old; bred by himself; sire, "Cambridge Duke 4th" (2570); dam, "Ama," by "Marquis of Exeter" (14,906); g. d. "Amy," by "Burglar" (10,007), gr. g. d. "Alice Hawthorn," by "Neptune" (7273).

Lord Braybrooke, Audley End, Saffron Walden, Essex: Third Prize, 10*l.*, for "Heydon Duke 2nd,' red, little white, 2 years, 4 months, 4 weeks-old; bred by himself; sire, "3rd Duke of Geneva" (23,753); dam, "Heydon Rose," by "Englishman" (19,701); g. d. "The Beauty," by "Puritan" (9523); gr. g. d. "Cambridge Rose 6th," by "Third Duke of York" (10,166).

Joseph Stratton, Alton Priors, Marlborough, Wilts: Fourth Prize, 5*l.*, for "Jack Frost," white, 2 years, 3 months, 6 days-old; bred by Mr. E. J. Smith, Islanmore, Croom, Limerick; sire, "Lictor" (24,333); dam, "Réchérché," by "Monk" (11,824); g. d. "Red Rose," by "Promoter" (10,658); gr. g. d., by "Acaster" (7755).

George Fox, Harefield, Fulshaw, Wilmslow, Cheshire, the *Reserve Number*, to "Leeman" (29,031), red and white, 2 years, 7 months, 3 weeks, 5 days-old; bred by Mr. W. Linton, Sheriff Hutton, York; sire, "Serjeant-Major" (29,957); dam, "Mushroom," by "Earl Windsor" (17,788); g. d. "Beauty 2nd," by "Magnus Troil" (14,880); gr. g. d., "Beauty," by "Bates" (12,451).

Shorthorns—Yearling Bulls above One and not exceeding Two Years old.

William Linton, Sheriff Hutton, York: First Prize, 25*l.*, for "Sir Arthur Ingram," roan, 1 year, 5 months, 6 days-old; bred by himself; sire, "Serjeant-Major" (29,957); dam, "Fragrance," by "Mountain Chief" (20,383); gr. d., "Topsy," by "Blood Royal" (17,423); gr. g. d. "York Lass," by "Magnus Troil" (14,880).

Sir George O. Wombwell, Bart., Newburgh Park, Easingwold, Yorkshire: Second Prize, 15*l.*, for "Newbro' 4th," red roan, 1 year, 4 months, 1 week, 6 days-old; bred by himself; sire, "Orestes" (22,443); dam, "Georgina," by "Vesuvius" (21,017); g. d. "Gertrude," by "Beppo (15,644); gr. g. d., "Garland by Sultan" (15,358).

William Lambe, Auburn, Lincoln: Third Prize, 10*l.*, for "Red Knight," red, 1 year, 2 months, 2 weeks, 2 days-old; bred by himself; sire, "Thorndale Lad" (23,066); dam, "Seaweed 2nd," by "Imperial Windsor" (18,086); g. d. "Seaweed," by "White Knight" (14,001); gr. g. d., by "Senator" (8552).

Joseph Meadows, Thornville, Wexford: Fourth Prize, 5*l.*, for "Ben Brace," white, 1 year, 1 month, 1 week-old; bred by himself; sire, "Bravo" (25,565); dam, "Bracelet 2nd," by "Vanguard" (21,009); g. d., "Bridal," by "Buckingham" (11,219); gr. g. d., "Lady of the Lake," by "Northern Light"(13,398).

The Hon. John Massey, Milford House, Limerick, Ireland: the *Reserve Number*, to "Forester," roan, 1 year, 10 months, 2 weeks, 6 days-old; bred by himself; sire, "Backwoodsman" (21,203); dam, "Vanity," by "Sheet Anchor" (18,820); g. d., "Beauty," by "Fugleman" (14,580); gr. g. d., "Variety," by "Cecil" (12,571).

Shorthorns—Bull Calves above Six and not exceeding Twelve Months old.

John Outhwaite, Bainesse, Catterick, Yorkshire: First Prize, 15*l.*, for "Lord Godolphin," roan, 10 months, 1 week, 3 days-old; bred by himself; sire, "Royal Windsor" (29,890); dam, "Whitesocks," by "Baron Killerby" (29,890); g. d. "Bertha," by "Welcome Guest" (15,947); gr. g. d., by "Vanguard" (10,994).

Henry Sharpley, Acthorpe, Louth, Lincolnshire: Second Prize, 10*l.*, for "Duke of Genoa," dark roan, 10 months, 2 weeks, 1 day-old; bred by himself; sire, "3rd Duke of Geneva" (23,753); dam, "Duenna," by "11th Grand Duke" (21,849); g. d. "Dulcinea," by "Duke of Geneva" (19,614); gr. g. d., "Duchess 1st," by "Master Rembrandt" (16,545).

Thomas Hare, Lund Cottage, Easingwold, Yorkshire: Third Prize, 5*l.*, for "Baron Irwin," roan, 10 months, 1 day-old; bred by himself; sire, "Lord Irwin" (29,122); dam, "Belle," by "Spearsby" (22,977); g. d., "Rosebud," by "General Friar" (21,811); gr. g. d., "Yorkshire Lass," by "Yorkshireman" (17,264).

Emily, Lady Pigot, Branches Park, Newmarket: the *Reserve Number*, to "Rapid Rhone," red roan, 6 months, 3 weeks-old; bred by herself; sire, "Bythis" (25,700); dam, "Dame Swift" by "Prince of Buckingham" (27,161); g. d., "Dame Quickly" by "Velasco" (15,443); gr. g. d., "Barmaid" by "British Prince" (14,197).

Shorthorns—Cows above Three Years old.

John Outhwaite, Bainesse, Catterick, Yorkshire: First Prize, 20*l.*, for "Vivandière" roan, 5 years, 3 weeks, 6 days-old, in calf; bred by himself; sire, "Brigade-Major" (21,312); dam, "Rosamond," by "Apollo," (9899); g. d., "Ruth," by "Albert" (7767); gr. g. d., "Rachel," by "Noble" (4579).

Alexander Henry Browne, Bank House, Acklington, Northumberland, Second Prize, 10*l.*, for "Primrose," red and white, 4 years, 7 months, 1 week, 2 days-old, in-milk; bred by Mr. L. C. Crisp, Hawkhill, Alnwick; sire, "Prowler" (22,662); dam, "Rose 2nd" by "Peak" (24,733); gr. d., "Napier Rosebud" by "Lord Napier" (14,832); gr. g. d. by "Sam Glen" (10,780).

Henry Frederick Smith, Lamwath House, Sutton, Hull: Third Prize, 5*l.*, for "Lamwath Violet," white, 3 years, 5 months, 4 weeks-old, in-milk; bred by himself; sire, "Booth's Kinsman" (25,658); dam, "Sweet White Violet" by "The Sutler" (23,061); g. d., "Violet" by "Prince George" (13,510); gr. g. d., "Carnation" by "Leo" (13,150).

Thomas Willis, Manor House, Carperby, Bedale, Yorkshire: the *Reserve Number*, to "Windsor's Bride," rich roan, 4 years, 3 months, 3 weeks-old, in-milk; bred by himself; sire, "Windsor Fitz-Windsor" (25,458); dam, "Blushing Bride," by "Fitz-Clarence" (14,552); g. d., "Maiden's Blush," by "Gipsy King" (11,532); gr. g. d., "Maid of Masham," by "Bernardo" (8885).

Shorthorns—Heifers, in-milk or in-calf, not exceeding Three Years old.

Oriel Viveash, Berwick Bassett, Swindon, Wilts: First Prize, 15*l.*, for "Mary Ann," red, 2 years, 3 months, 1 week, 1 day-old, in-calf; bred by himself; sire, "James 1st" (24,202); dam, "Mary," by "8th Duke of York" (23,808); g. d., "Martha," by "Roderick" (18,730); gr. g. d., "Merry Maid," by "The Baronet" (17,088).

Francis John Savile Foljambe, M.P., Osberton Hall, Worksop, Notts: Second Prize, 10*l.*, for "Zingara," roan, 2 years, 5 months, 1 week-old, in-calf; bred by himself; sire, "Knight of the Crescent (26,547); dam, "Zinganee," by "Knight of the Garter" (22,062); g. d., "Gipsy Queen," by "Imperial Windsor" (18,086; gr. g. d., "Sybil," by "May Duke" (16,553).

George Garne, Churchill Heath, Chipping Norton, Oxfordshire: Third Prize, 5*l.*, for "Butterfly's Duchess," roan, 2 years, 11 months, 2 weeks, 1 day-old, in-milk, and in-calf; bred by himself; sire, "Royal Butterfly 20th" (25,007); dam, "Delicacy," by "The Druid" (20,948); gr. d., "Destiny," by "Progression" (16,770); g. gr. d., "Damsel" by "Enterprise" (11,443).

George Garne, Churchill Heath: the *Reserve Number*, to "Partridge," red, 2 years, 10 months-old, in milk and in-calf; bred by himself; sire, "Royal Butterfly 20th" (25,007); dam, "Panacea," by "General Pelissier" (14,605); g. d., "Pane," by "Bashaw" (12,449); gr. g. d., "Panic," by "Colchicum" (8963).

Shorthorns—Yearling Heifers, above One and not exceeding Two Years old.

Emily, Lady Pigot, Branches Park, Newmarket: First Prize, 15*l.*, for "Rose of Wytham," red and white, 1 year, 8 months-old; bred by herself; sire, "Gunpowder" (28,801); dam, "Imperial Rose 2nd," by "Prince of Empire" (20,578), g. d. "Imperial Rose," by "Prince Imperial" (15,095); gr. g. d., "Red Rose," by "Vanguard" (10,994).

William and Henry Dudding, Panton House, Wragby, Lincolnshire: Second Prize, 10*l.*, for "Blooming Bride," red, 1 year, 11 months, 1 week-old; bred by themselves; sire, "Robin" (24,968); dam, "Bloomer," by "Lord Panton" (22,204); g. d., "Birthright," by "Royal Favourite" (15,200); gr. g. d., "Daisy," by "Sylvan" (10,907).

John Outhwaite, Bainesse, Catterick, Yorkshire: Third Prize, 5*l.*, for "Baroness Conyers," roan, 1 year, 9 months, 2 weeks, 1 day-old; bred by himself; sire, "Baron Killerby" (27,949); dam, "Sylvia," by "Champion" (23,529); g. d., "Sunflower," by "Son of Apollo" (9899); gr. g. d., "Sally," by "Chieftain" (10,048).

Teesdale Hilton Hutchinson, Manor House, Catterick, Yorkshire: the *Reserve Number*, to "Lady Playful," roan, 1 year, 7 months, 3 weeks-old; bred by himself; sire, "Merry Monarch" (22,349); dam, "Lady Sophia," by "Brigade Major" (21,312); g. d, "Lady of the Manor," by "Baron Warlaby" (7813); gr. g. d., "Lady Burton," by "Vesuvius" (5559).

Shorthorns—Heifer Calves, above Six and under Twelve Months old.

Lord Sudeley, Toddington, Winchcombe, Gloucestershire: First Prize, 10*l.*, for "Seraphina Bella 2nd," roan, 7 months, 3 days-old; bred by himself; sire, "Mandarin" (29,269); dam, "Booth's Seraphina," by "Baron Booth" (21,212); g. d., "Seraphina 13th," by "John O'Gaunt" (16,322); gr. g. d., Seraphina 7th," by "Duke of Sussex" (12,772).

Thomas Horrocks Miller, Singleton, Poulton-le-Fylde, Lancashire: Second Prize, 5*l.*, for "Ringlet 4th," roan, 10 months, 3 weeks, 6 days-old; bred by himself; sire, "White Duke;" dam, "Ringlet 2nd," by "Bywell Victor" (21,353); g. d., "Ringlet," by "Lord of the Valley" (14,837); gr. g. d., "Rose Duchess," by "Red Duke" (13,571).

Sir George O. Wombwell, Bart., Newburgh Park, Easingwold, Yorkshire: the *Reserve Number*, to "Cerito 2nd," roan, 7 months, 2 weeks, 1 day-old; bred by himself; sire, "Duke of Oxford 20th" (28,432); dam, "Cerito," by "Vesuvius" (21,017); g. d., "Calcutta," by "Skyrocket" (15,306); gr. g. d., "China," by "Fourth Duke of York" (10,167).

Herefords—Bulls above Three Years old.

Philip Turner, The Leen, Pembridge, Leominster, Herefordshire: First Prize, 25*l.*, for "Provost" (4067), red, white face, 4 years, 1 week-old; bred by himself; sire, "Bachelor" (2941); dam, "Rhodia;" sire of dam, "Subaltern" (2794).

Joseph Evans Spencer, Lancadle, Cowbridge, Glamorganshire: Second Prize, 15*l.*, for "Von Moltke" (4234), red, white face, 3 years, 5 months, 2 weeks, 5 days-old; bred by Mr. Warren Evans, Llandowlais, Usk, Monmouthshire; sire, "Prince Arthur" (2695); dam, "Dames Violet 3rd" sire of dam, "Monaughty" (2117).

Thomas James Carwardine, Stockton Bury, Leominster: the *Reserve Number*, to "De Cote," red, white face, 5 years, 1 month, 3 days-old; bred by the late Mr. Thomas Edwards, Wintercott, Leominster; sire, "Tomboy" (3546); dam, "Barmaid;" sire of dam, "Royal George" (2197).

Herefords—Bulls above Two and not exceeding Three Years old.

Sarah Edwards, Wintercott, Leominster, Herefordshire: First Prize, 25*l.*, for "Winter De Cote" (4253), red, white face, 2 years, 10 months, 3 weeks-old; bred by the late Mr. Thomas Edwards, Wintercott, Leominster; sire, "Leominster 3rd" (3211); dam, "Pinky 3rd;" sire of dam, "Young Grove" (2888).

Warren Evans, Llandowlais, Usk, Monmouthshire: Second Prize, 15*l.*, for "Enterprise," red, white face, 2 years, 8 months, 2 weeks, 1 day-old;

bred by Mr. Child, Westonbury, Pembridge; sire, "Theodore;" dam, "Fair Maid;" sire of dam, "Wellington" (1112).

JOHN HARDING, The Greenhouse, Alveley, Bridgnorth, Salop: the *Reserve Number*, to "Lord Battenhall," red, white face, 2 years, 5 months, 4 weeks-old; bred by himself; sire, "Battenhall" (2406); dam, "Theora;" sire of dam, "Sebastopol" (1381).

Herefords—Yearling Bulls above One and not exceeding Two Years old.

HENRY JAMES BAILEY, Rosedale, Tenbury, Herefordshire: FIRST PRIZE, 25*l.*, for "King of the Dale" (3891), red, white face, 1 year, 6 months, 3 weeks-old; bred by himself; sire, "Prince Charles" (4041); dam, "Queen of the Valley 2nd;" sire of dam, "Battenhall" (2406).

EDWARD LISTER, Cefn Ila, Usk, Monmouthshire: SECOND PRIZE, 15*l.*, for "Black Eagle," red, white face, 1 year, 5 months, 3 weeks, 2 days-old; bred by himself; sire, "Chanter" (3738); dam, "Cherry;" sire of dam, "Orphan" (2622).

HER MAJESTY THE QUEEN, Windsor Castle: THIRD PRIZE, 5*l.*, for "Marquis of Lorne," red, white face, 1 year, 10 months, 2 weeks, 2 days-old; bred by Her Majesty, at Flemish Farm, Windsor; sire, "Prince George Frederick;" dam, "Princess Mary;" sire of dam, "Ajax."

WARREN EVANS, of Llandowlais, Usk, Monmouthshire: the *Reserve Number*, to "Von Moltke 2nd," red, white face, 1 year, 5 months, 2 weeks-old; bred by himself; sire, "Von Moltke" (4234); dam, "Countess 3rd;" sire of dam, "Monaughty" (2117).

Herefords—Bull Calves above Six and not exceeding Twelve Months old.

SARAH EDWARDS, Wintercott, Leominster, Herefordshire: FIRST PRIZE, 10*l.*, for "Student," red, white face, 10 months, 2 weeks, 5-days-old; bred by herself; sire, "Winter De Cote" (4253); dam, "Lovely;" sire of dam, "Tomboy" (3546).

CHARLES HENRY HINCKESMAN, the Poles, Ludlow: SECOND PRIZE, 5*l.*, for "Sir Wilfred," red, white face, 11 months, 1 day-old; bred by himself; sire, "Battenhall" (2406); dam, "Churchhouse 6th;" sire of dam, "Agriculturist" (1842).

THOMAS FENN, Stonebrook House, Ludlow: the *Reserve Number*, to "Master Teme," red, 11 months, 4 weeks-old: bred by himself; sire, "Severus 2nd" (2747); dam, "Miss Teme;" sire of dam, "Weston" (3597).

Herefords—Cows above Three Years old.

WILLIAM BURCHALL PEREN, Compton House, South Petherton, Somerset: FIRST PRIZE, 20*l.*, for "Ivington Rose," red, white face, 8 years, 10 months, 4 days-old, in-calf; bred by Mr. Thomas Roberts, Lawton Bury, Leominster; sire, "Sir Thomas" (2228); dam, "Red Rose;" sire of dam, "Master Butterfly" (1313).

RICHARD TANNER, Frodesley, Dorrington, Salop: SECOND PRIZE, 5*l.*, for "Lady Milton," red, white face, 4 years, 11 months, 3 weeks, 5 days-old, in-calf; bred by the late Mr. J. V. Ashwood, Longden Hall, Wellington, Salop; sire, "Chieftain the 5th" (3018); sire of dam, "Milton" (2114).

Warren Evans, Llandowlais, Usk, Monmouthshire: the *Reserve Number*, to "Lady 2nd," red, white face, 6 years, 7 months, 1 week, 6 days-old, in-calf; bred by himself; sire, "Hopeful" (2045); dam, "Nena 2nd;" sire of dam, "Oakley" (1673).

Herefords—Heifers in-milk or in-calf, not exceeding Three Years old.

The Earl of Southesk, K.T., Kinnaird Castle, Brechin, N.B.: First Prize, 15*l*., for "Desdemona," red, white face, 2 years, 10 months, 2 weeks, 6 days-old, in-calf; bred by himself; sire, "Orleans" (2661); dam, "Diadem;" sire of dam, "Chieftain 4th" (2458).

Herefords—Yearling Heifers above One and not exceeding Two Years old.

Philip Turner, The Leen, Pembridge: First Prize, 15*l*., for "Exquisite," red, white face, 1 year, 10 months, 1 week, 2 days-old; bred by himself; sire, "Provost" (4067); dam, "Norma;" sire of dam, "Bolingbroke" (1883).

Philip Turner, The Leen, Pembridge: Second Prize, 10*l*., for "Satellite," red, white face, 1 year, 10 months, 2 weeks, 2 days-old; bred by himself; sire, "Bachelor" (2941); dam, "Luna;" sire of dam, "Franky;" (1243).

Henry Nicholas Edwards, Broadward, Leominster, Herefordshire: Third Prize, 5*l*., for "Annie 2nd," red, white face, 1 year, 9 months, 3 weeks, 3 days-old; bred by himself; sire, "Sir John" (3451); dam, "Annie;" sire of dam, "Dan O'Connell" (1952).

Her Majesty the Queen, Windsor Castle: the *Reserve Number*, to "Princess Louise Victoria," red, white face, 1 year, 6 months, 1 week, 4 days-old; bred by Her Majesty, at Flemish Farm, Windsor; sire, "Prince Leopold;" dam, "Adelaide 2nd;" sire of dam, "Deception."

Herefords—Heifer Calves above Six and under Twelve Months old.

Philip Turner, The Leen, Pembridge, Herefordshire: First Prize, 10*l*., for "Verbena," red, white face, 11 months, 4 weeks, 1 day-old; bred by himself; sire, "Provost" (4067); dam, "Luna;" sire of dam, "Franky" (1243).

Henry Nicholas Edwards, Broadward, Leominster, Herefordshire: Second Prize, 5*l*., for "Dolly," red, white face, 11 months, 3 days-old; bred by himself; sire, "Albert" (3648); dam, "Dahlia 2nd;" sire of dam, "San-ja-Cinto" (2209).

William Burchell Peren, Compton House, South Petherton, Somerset: the *Reserve Number*, to "Lady Lavender," red, white face, 11 months, 1 week-old; bred by himself; sire, "Sir William" (4141); dam, "Nonparcil;" sire of dam, "Priam" (3334).

Devons—Bulls above Three Years old.

Viscount Falmouth, Tregothnan, Probus, Cornwall: First Prize, 25*l*., for "Jonquil," red, 4 years, 9 months, 3 weeks, 3 days-old; bred by himself; sire, "Sunflower" (937); dam, "Picture 4th" (2224); sire of dam, "Napoleon" (464).

Walter Farthing, Stowey Court, Bridgwater, Somersetshire: Second Prize, 15*l*., for "Master Harry," red, 3 years, 6 months, 3 weeks, 2 days-old bred by himself; sire, "Master Arthur;" dam, "Lofty;" sire of dam, "Sir Peregrine."

VISCOUNT FALMOUTH, Tregothnan, Probus, Cornwall: the *Reserve Number*, to "Kingcraft," red, 3 years, 11 months, 2 weeks-old; bred by himself; sire, "Sunflower" (937); dam, "Peach" (2905A); sire of dam, "Young Forester" (759).

Devons—Bulls above Two and not exceeding Three Years old.

The EXECUTRIX of the late Mr. JAMES DAVY, Flitton Barton, North Molton, Devon: FIRST PRIZE, 25*l.*, for "Duke of Flitton 8th," red, 2 years, 2 months, 2 weeks, 2 days-old; bred by the late Mr. James Davy; sire, "Duke of Flitton 4th" (827); dam, "Temptress 2nd" (3070); sire of dam, "Duke of Cornwall" (820).

HER MAJESTY THE QUEEN, Windsor Castle: the *Reserve Number*, to "Prince Imperial," red, 2 years, 10 months, 2 days-old; bred by Her Majesty, at Norfolk Farm, Windsor Park; sire, "Napier;" dam, "Princess Beatrice;" sire of dam, "Prince Alfred."

Devons—Yearling Bulls above One and not exceeding Two Years old.

WALTER FARTHING, Stowey Court, Bridgwater, Somerset: FIRST PRIZE, 25*l.*, for "Master Robin," red, 1 year, 11 months, 4 weeks, 1 day-old; bred by himself; sire, "Master Arthur;" dam, "Verbena."

The EXECUTRIX of the late Mr. JAMES DAVY, Flitton Barton, North Molton, Devon: the *Reserve Number*, to "Duke of Flitton 10th," red, 1 year, 6 months, 3 weeks, 6 days-old; bred by the late Mr. James Davy; sire, "Duke of Flitton 5th;" dam, "Lavender" (2819); sire of dam, "Admiral" (771A).

Devons—Bull Calves above Six and not exceeding Twelve Months old.

The EXECUTRIX of the late Mr. JAMES DAVY, Flitton Barton, North Molton, Devon: FIRST PRIZE, 10*l.*, for "Duke of Plymouth," red, 7 months, 3 weeks-old; bred by the late Mr. James Davy; sire, "Duke of Flitton 5th;" dam, "Duchess of Plymouth" (2661); sire of dam, "Gold Medal Duke of Flitton" (613).

WALTER FARTHING, Stowey Court, Bridgwater, Somerset: SECOND PRIZE, 5*l.*, for his red, 6 months, 2 weeks, 1 day-old; bred by himself; sire, "Able;" dam, "Cheerful;" sire of dam, "Duke of Gothelney."

WALTER FARTHING, Stowey Court: the *Reserve Number*, to his red, 7 months, 1 week, 4 days-old; bred by Sir Alexander Acland Hood, Bart., St. Audries, Bridgwater.

Devons—Cows above Three Years old.

TREVOR LEE SENIOR, Broughton House, Aylesbury, Bucks: FIRST PRIZE, 20*l.*, for "Moss Rose," light red, 5 years, 3 months, 3 weeks-old, in-calf; bred by the late Mr. Wilkinson, Isle of Wight; sire, "Island Prince;" dam, "Modesty."

JOHN AZARIAH SMITH, Bradford Peverell, Dorchester: SECOND PRIZE, 10*l.*, for "Picture," red, 3 years, 3 months, 2 weeks, 6 days-old, in-milk; bred by himself; sire, "Stratton;" dam, "Picture; sire of dam, "Augustus" (778).

The Executrix of the late Mr. James Davy, Flitton Barton, North Molton, Devon: the *Reserve Number*, to "Lavender" (2819), red, 7 years, 1 week, 1 day-old, in-calf; bred by the late Mr. James Davy; sire, "Admiral," (771A); dam, "Picture 6th" (2226); sire of dam, "Prince Alfred" (491).

Devons—Heifers in-milk or in-calf, not exceeding Three Years old.

The Executrix of the late Mr. James Davy, Flitton Barton, North Molton, Devon: First Prize, 15*l.*, for "Temptress 3rd," red, 2 years, 3 weeks, 1 day-old, in-calf; bred by the late Mr. James Davy; sire, "Duke of Flitton 4th" (827); dam, "Gold Medal Temptress" (1672);" sire of dam, "Davy's Napoleon 3rd" (464).

John Azariah Smith, Bradford Peverell, Dorchester: Second Prize, 10*l.*, for "Honest," red, 2 years, 7 months, 3 weeks-old, in-calf; bred by himself; sire, "Duke of York;" dam, "Honest;" sire of dam, "Trio" (940).

George Turner, Brampford Speke, Exeter: the *Reserve Number*, to "Devoniensis," red, 2 years, 9 months, 1 week, 3 days-old, in-calf; bred by himself; sire, "Frank Quartly;" dam, "Duchess 4th."

Devons—Yearling Heifers, above One and not exceeding Two Years old.

John Azariah Smith, Bradford Peverell, Dorchester: First Prize, 15*l.*, for "Picture," red, 1 year, 9 months, 2 weeks, 1 day-old; bred by himself; sire, "Duke of York;" dam, "Picture;" sire of dam, "Augustus" (778).

George Turner, Brampford Speke, Exeter: Second Prize, 10*l.*, for "Muriel," red, 1 year, 11 months, 1 week, 3 days-old; bred by himself; sire, "Marquis of Lorne;" dam, "Duchess 3rd."

Trevor Lee Senior, Broughton House, Aylesbury: the *Reserve Number*, to "Lady Maude," red, 1 year, 7 months, 3 weeks-old; bred by himself; sire, "Stowey;" dam, "Young Daisey."

Devons—Heifer-Calves above Six and under Twelve Months old.

The Executrix of the late Mr. James Davy, Flitton Barton, North Molton, Devon: First Prize, 10*l.*, for "Princess Alice 4th," red, 7 months, 4 weeks-old; bred by the late Mr. James Davy; sire, "Duke of Flitton 5th;" dam, "Princess Alice 2nd" (2971); sire of dam, "Duke of Flitton 2nd" (825).

Trevor Lee Senior, Broughton House, Aylesbury: Second Prize, 5*l.*, for "Moss Rose 1st," red, 11 months, 3 weeks-old; bred by himself; sire, "Stowey;" dam, "Moss Rose."

Viscount Falmouth, Tregothnan, Probus, Cornwall: the *Reserve Number*, to his red, 11 months, 1 week, 3 days-old; bred by himself; sire, "Jonquil;" dam, "Rubra."

Jerseys—Bulls above One Year old.

Lord Chesham, Latimer, Chesham, Bucks: First Prize, 10*l.*, for "Baron," dark silver grey, 2 years, 1 month, 3 weeks-old; bred by himself.

Walter Gilbey, Hargrave Park, Stanstead, Essex: Second Prize, 5*l.*, for "Don," fawn, 2 years, 2 months-old; breeder unknown.

George Digby Wingfield-Digby, Sherborne Castle, Dorset: the *Reserve Number*, to "Cowboy," fawn, about 3 years-old; bred by Mr. J. Balleind, Jersey.

Jerseys—Cows above Three Years old.

George Simpson, Wray Park, Reigate, Surrey: First Prize, 10*l.*, for "Gentle," grey fawn, 3 years, 11 months-old, in-milk; breeder unknown.

Walter Gilbey, Hargrave Park, Stanstead, Essex: Second Prize, 5*l.*, for "Lady Grey," fawn, 5 years, 1 month-old, in-milk; bred by Mr. P. Gaudin, of Spring Farm, St. Martin's, Jersey; sire, "Clement;" dam, "Lady Best."

Walter Gilbey, Hargrave Park: the *Reserve Number*, to "Duchess," fawn, 5 years, 4 months, 3 weeks-old, in-milk; bred by Mr. H. J. Le Feuvre, St. Peter's, Jersey; sire, "Cardinal;" dam, "Queen Mab."

Jerseys—Heifers, in-milk or in-calf, not exceeding Three Years old.

Walter Gilbey, Hargrave Park, Stanstead, Essex: First Prize, 10*l.*, for "Tal," fawn, 2 years, 11 months, 3 weeks-old, in-milk; breeder unknown.

George Simpson, Wray Park, Reigate, Surrey: Second Prize, 5*l.*, for "Madge," fawn, 2 years, 3 months, 1 week-old, in-milk; bred by himself; sire, "Prince;" dam, "Madcap;" sire of dam, "The Young Duke."

George Digby Wingfield-Digby, Sherborne Castle, Dorset: the *Reserve Number*, to "Queen of the Vale," lemon, 2 years, 8 months, 3 days-old, in-calf: bred by himself; sire, "Sir Jerry;" dam, "Picture."

Guernseys—Bulls above One Year old.

The Rev. Joshua Rundle Watson, La Favorita, Guernsey: First Prize, 10*l.*, for "Cloth of Gold," fawn, 2 years, 3 months, 3 weeks, 4 days-old; bred by Mr. Robin, Les Landes, Guernsey; sire, "Fair Lad;" dam, "La Charbonnée."

Thomas Maindonald, Les Epérons, Guernsey: Second Prize, 5*l.*, for "Billy," pale red and white, 2 years, 2 weeks, 2 days-old; bred by himself.

Thomas Statter, Stand Hall, Whitefield, Manchester: the *Reserve Number*, to "Poitou," yellow and white, 2 years, 6 months, 2 weeks, 2 days-old; bred by himself.

Guernseys—Cows above Three Years old.

Thomas Maindonald, Les Epérons, Guernsey: First Prize, 10*l.*, for "Charlotte," pale red and white, 5 years, 2 months-old, in-calf: bred by Morish, Clos du Valle, Guernsey.

John Shaw, Beech Hill, Swanland, Yorkshire: Second Prize, 5*l.*, for his yellow and white, 5 years-old, in-milk; bred by Mr. C. Le Page, St. Andrew's, Guernsey; sire, "Champion."

Thomas Maindonald, Les Epérons, the *Reserve Number*, to "Luce," black and white, 4 years, 3 months, 1 week-old, in-calf; bred by Mr. Le Lacheur, Les Norgiots, St. Andrew's, Guernsey.

Guernseys—Heifers, in-milk or in-calf, not exceeding Three Years old.

The Rev. Joshua Rundle Watson, La Favorita, Guernsey: First Prize, 10*l.*, for "Bijou," red and white, 2 years-old, in-calf; bred by Mr. James, La Quevilette, Guernsey; sire, "Trumpeter."

Galloways—Bulls above Two Years old.

James Graham, Parcelstown, Longtown, Cumberland: First Prize, 10*l.*, for "Willie of Westburnflat" (523), black, 7 years, 2 months, 3 weeks-old; bred by Mr. W. Keir, Whithaugh, Newcastleton, Roxburgh; sire, "Jock;" dam, "Bess of Whithaugh;" sire of dam, "Border Reiver."

John Fisher, Knells, Carlisle, Cumberland: Second Prize, 5*l.*, for "Squire Dacre" (534), black, 6 years, 4 months, 3 days-old; bred by Mr. J. Graham, Parcelstown, Longtown; sire, "Border Knight" (539); dam, "Rose of Galloway" (1311); sire of dam, "Sir James" (537).

Galloways—Cows above Three Years old.

Walton Raine, Low Wanwood, Alston, Cumberland: First Prize, 10*l.*, for "Queen of the Tyne," black, 6 years, 2 months, 1 week, 4 days-old; in-calf; bred by himself.

The Duke of Buccleuch and Queensbury, K.G., Drumlanrig Castle, Thornhill, Dumfriesshire: Second Prize, 5*l.*, for "Jean," black, 7 years, 4 months-old, in-milk; bred by Mr. J. Giffard, Torhouskie, Newton Stewart; sire, "Wallace;" dam, "Jean."

The Duke of Buccleuch and Queensbury, K.G., Drumlanrig Castle, the *Reserve Number*, to "Louisa 2nd" (1379), black, 3 years, 4 months, 3 weeks, 4 days-old, in-milk; bred by Mr. J. Cunningham, Tarbruch, Dalbeattie; sire, "Havelock" (544); dam, "Louisa."

Galloways—Heifers, in-milk or in-calf, under Three Years old.

James Graham, Parcelstown, Longtown, Cumberland: First Prize, 10*l.*, for "Dame Margaret Douglas" (1327), black, 2 years, 8 months, 2 weeks-old, in-calf; bred by himself; sire, "Willie of Westburnflat" (523); dam, "2nd Hannah" (1317); sire of dam, "Glenorcky" (521).

James Graham, Parcelstown: Second Prize, 5*l.*, for "Queen of Lyne" (1328), black, 2 years, 8 months, 1 week-old, in-calf; bred by himself; sire, "Willie of Westburnflat" (523); dam, "Forest Queen" (1314); sire of dam, "Sir Walter" (536).

Ayrshires—Bulls above Two Years old.

Thomas Statter, Stand Hall, Whitefield, Manchester: First Prize, 10*l.*, for "The Hero," red and white, about 3 years-old; breeder unknown.

Ayrshires—Cows above Three Years old.

Thomas Statter, Stand Hall, Whitefield, Manchester: First Prize, 10*l.*, for "Maid of Ayr," red and white, about 4 years, 6 months-old, in-milk; breeder unknown.

Ayrshires—Heifers in-milk or in-calf, under Three Years old.

Thomas Statter, Stand Hall, Whitefield, Manchester: First Prize, 10*l.*, for "Lassie," red and white, between 2 and 3 years-old, in-milk; breeder unknown.

Other Established Breeds—Bulls above One Year old.

LORD SONDES, Elmham Hall, Dereham, Norfolk: FIRST PRIZE, 10*l.*, for his (Norfolk Polled), red, 2 years, 3 months, 2 weeks-old; bred by himself.

BENJAMIN BROWN, Thursford, Dereham, Norfolk: SECOND PRIZE, 5*l.*, for "Norfolk Duke" (Norfolk Polled), red, 8 years, 3 weeks-old; bred by Mr. N. Powell, Little Snoring, Fakenham.

JEREMIAH JAMES COLMAN, M.P., Carrow House, Norwich: the *Reserve Number*, to "Cherry Duke" (Norfolk Polled), blood red, 5 years, 4 months, 2 weeks-old; bred by Mr. S. Wolton, Newbourne Hall, Woodbridge; sire, "Esquire;" dam, "Beauty."

Other Established Breeds—Cows above Three Years old.

BENJAMIN BROWN, Thursford, Dereham, Norfolk: FIRST PRIZE, 10*l.*, for "Countess" (Norfolk Polled), red, 4 years, 3 months, 2 days-old, in-milk, and in-calf; bred by himself; sire, "Norfolk Duke;" dam, "Hansom;" sire of dam, "Tenant Farmer."

JEREMIAH JAMES COLMAN, M.P., Carrow House, Norwich: SECOND PRIZE, 5*l.*, for "Buttercup" (Norfolk Polled), blood red, 5 years, 7 months, 3 weeks-old, in milk and in-calf; bred by Mr. J. Hammond, Bale, Thetford; sire, "Sir Nicholas;" dam, "Butler."

LORD SONDES, Elmham Hall, Dereham, Norfolk: the *Reserve Number*, to "Brownie" (Norfolk Polled), red, 3 years, 7 months-old, in-calf; bred by Mr. B. Brown, Thursford, Dereham.

Other Established Breeds—Heifers in-milk or in-calf, not exceeding Three Years old.

LORD SONDES, Elmham Hall, Dereham, Norfolk: FIRST PRIZE, 10*l.*, for "Minnie 3rd" (Norfolk Polled), red, 2 years, 4 months-old, in-calf; bred by himself.

JEREMIAH JAMES COLMAN, M.P., Carrow House, Norwich: SECOND PRIZE, 5*l.*, for "Handsome" (Norfolk Polled), blood red, 2 years, 11 months, 2 weeks, 3 days-old, in milk and in-calf; bred by Mr. Brown, Thursford; sire, "Norfolk Duke;" dam, "Thursford Handsome;" sire of dam, "Tenant Farmer."

*Pairs of Dairy Cows of any breed, for breeding and milking purposes.**

WILLIAM DUNN, Ellerby Grange, Skirlaugh, Hull: FIRST PRIZE, 10*l.*, for his Shorthorns, red and white, 7 years-old; light hazel, 5 years-old; both bred by himself.

THOMAS STATTER, Stand Hall: SECOND PRIZE, 5*l.*, for his Yorkshires, "Dairy Maid" and "Buttercup," roan, about 5 years-old; breeders unknown.

*Pairs of Three-Years-old Heifers of any breed, in milk-or in-calf.**

GEORGE ASHBURNER, Low Hall, Broughton-in-Furness, Lancashire: FIRST PRIZE, 10*l.*, for his Shorthorns, "Duchess of Kirkby," roan, 3 years, 3 months, 1 week, 4 days-old; bred by himself; sire, "Grand Duke 10th"

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* Given by the Hull Butchers.

(21,848); dam, "Nightingale Oxford," by "Oxford" (20,449); and "Florence," red, 3 years, 3 months, 2 weeks, 2 days-old; bred by Mr. T. Waller, Berkswell, Coventry; sire, "Grand Duke 9th" (19,879); dam, "Rosette" by "Marmaduke" (14,897).

JAMES and WILLIAM MARTIN, Newmarket, Aberdeen: SECOND PRIZE, 5*l.*, for their red, 2 years, 3 months, 2 days-old; and red, little white, 2 years, 3 months, 2 weeks, 4 days-old; bred by Mr. J. Morrison, Upper Cotburn, Banffshire.

SHEEP.

Leicesters—Shearling Rams.

GEORGE TURNER, Jun., Thorpelands, Northampton: FIRST PRIZE, 20*l.*, for his about 1 year, 3 months-old; bred by himself.

JOHN BORTON, Barton House, Barton-le-Street, Malton, Yorkshire: SECOND PRIZE, 10*l.*, for his 1 year, 4 months-old; bred by himself.

GEORGE TURNER, Jun., Thorpelands: THIRD PRIZE, 5*l.*, for his about 1 year, 3 months-old; bred by himself.

GEORGE TURNER, Jun., Thorpelands: the *Reserve Number*, to his about 1 year, 3 months-old; bred by himself.

Leicesters—Rams of any other age.

THOMAS MARRIS, The Chase, Ulceby, Lincolnshire: FIRST PRIZE, 20*l.*, for his 2 years, 3 months, 3 weeks-old; bred by himself.

JOHN BORTON, Barton House, Malton: SECOND PRIZE, 10*l.*, for his 2 years, 4 months-old; bred by himself.

JOHN BORTON, Barton House: THIRD PRIZE, 5*l.*, for his 4 years, 4 months-old; bred by himself.

JOHN BORTON, Barton House: the *Reserve Number*, to his 3 years, 4 months-old; bred by himself.

Leicesters—Pens of Five Shearling Ewes.

GEORGE TURNER, Jun., Thorpelands, Northampton: FIRST PRIZE, 15*l.*, for his 1 year, 3 months-old: bred by himself.

JOHN BORTON, Barton House, Barton-le-Street, Malton: SECOND PRIZE, 10*l.*, for his 1 year, 4 months-old; bred by himself.

TEASDALE HILTON HUTCHINSON, Manor House, Catterick: THIRD PRIZE, 5*l.*, for his various ages; bred by himself.

TEASDALE H. HUTCHINSON, Manor House, Catterick: the *Reserve Number*, to his various ages; bred by himself.

Cotswolds—Shearling Rams.

THOMAS BROWN, Marham Hall Farm, Downham Market, Norfolk: FIRST PRIZE, 20*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

THOMAS BROWN, Marham Hall Farm: SECOND PRIZE, 10*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

THOMAS BROWN, Marham Hall Farm: THIRD PRIZE, 5*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

RUSSELL SWANWICK, the Royal Agricultural College Farm, Cirencester: the *Reserve Number*, to his 1 year, 4 months, 2 weeks-old; bred by himself.

Cotswolds—Rams of any other Age.

THOMAS BROWN, Marham Hall Farm, Downham Market: FIRST PRIZE, 20*l.*, for his 3 years, 4 months, 2 weeks-old; bred by himself.

THOMAS BROWN, Marham Hall Farm: SECOND PRIZE, 10*l.*, for his 4 years, 4 months, 2 weeks-old; bred by himself.

RUSSELL SWANWICK, Royal Agricultural College Farm, Cirencester: THIRD PRIZE, 5*l.*, for his 2 years, 4 months, 3 weeks-old; bred by himself.

THOMAS BROWN, Marham Farm, the *Reserve Number*, to his 3 years, 4 months, 2 weeks-old; bred by himself.

Cotswolds—Pens of Five Shearling Ewes.

MARY GODWIN, Troy Farm, Somerton, Deddington, Oxon: FIRST PRIZE, 15*l.*, for her about 1 year, 4 months-old; bred by herself.

RUSSELL SWANWICK, Royal Agricultural College Farm, Cirencester: SECOND PRIZE, 10*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

T. BEALE BROWN, Salperton Park, Andoversford, Gloucestershire: THIRD PRIZE, 5*l.*, for his 1 year, 3 months-old; bred by himself.

T. BEALE BROWN, Salperton Park: the *Reserve Number*, to his 1 year, 3 months-old; bred by himself.

Lincolns—Shearling Rams.

WILLIAM and HENRY DUDDING, Panton House, Wragby, Lincolnshire: FIRST PRIZE, 20*l.*, for their 1 year, 3 months, 3 weeks-old; bred by themselves.

EDWARD JOHN HOWARD, Nocton Rise, Lincolnshire: SECOND PRIZE, 10*l.*, for his 1 year, 3 months, 2 weeks-old; bred by himself.

JOHN PEARS, Mere, Lincolnshire: THIRD PRIZE, 5*l.*, for his 1 year, 4 months-old; bred by himself.

CHARLES CLARKE, Ashby-de-la-Launde, Sleaford: the *Reserve Number*, to his 1 year, 4 months, 1 week-old; bred by himself.

Lincolns—Rams of any other Age.

WILLIAM and HENRY DUDDING, Panton House, Wragby: FIRST PRIZE, 20*l.*, for their 2 years, 3 months, 3 weeks-old; bred by themselves.

WILLIAM F. MARSHALL, Branston, Lincoln: SECOND PRIZE, 10*l.*, for his 3 years, 4 months, 2 weeks-old; bred by Mr. T. Casswell, Ponton.

JOHN PEARS, Mere, Lincolnshire: THIRD PRIZE, 5*l.*, for his 3 years, 4 months-old; bred by himself.

Lincolns—Pens of Five Shearling Ewes.

JOHN BYRON, Kirkby Green, Sleaford, Lincolnshire: FIRST PRIZE, 15*l.*, for his 1 year, 3 months-old; bred by himself.

Charles Clarke, Ashby-de-la-Launde, Sleaford: Second Prize, 10*l.*, for his 1 year, 4 months-old; bred by himself.

William Hesseltine, Beaumont Cote, Barton-on-Humber: Third Prize, 5*l.*, for his about 1 year, 3 months-old; bred by himself.

Richard Newcomb Morley, Leadenham, Grantham: the *Reserve Number*, to his 1 year, 4 months, 2 weeks-old; bred by himself.

Border Leicesters—Shearling Rams.

Thomas Forster, Jun., Ellingham, Chathill, Northumberland: First Prize, 20*l.*, for his 1 year, 3 months-old; bred by himself.

Alexander Bell, Linton, Kelso, Roxburgh, N.B.: Second Prize, 10*l.*, for his 1 year, 3 months, 2 weeks-old; bred by himself.

William Purves, Linton Burnfoot, Kelso, Roxburgh, N.B.: Third Prize, 5*l.*, for his 1 year, 3 months, 2 weeks-old; bred by himself.

William Purves, Linton Burnfoot: the *Reserve Number*, to his 1 year, 3 months, 2 weeks-old; bred by himself.

Border Leicesters—Rams of any other Age.

Thomas Forster, Jun., Ellingham, Chathill, Northumberland: First Prize, 20*l.*, for his 3 or 4 years-old; bred by himself.

Thomas Forster, Jun., Ellingham: Second Prize, 10*l.*, for his about 4 years, 3 months-old; bred by Miss Stark, of Mellendean, Kelso, Roxburgh.

George Laing, Wark, Coldstream, Northumberland: Third Prize, 5*l.*, for his 2 years, 3 months-old; bred by himself.

Richard Tweedie, The Forest, Catterick: the *Reserve Number*, to "Boxer," 3 years, 3 months-old; bred by himself; sire, "Knight of Lothian;" sire of dam, "Stark 5th."

Border Leicesters—Pens of Five Shearling Ewes.

William Purves, Linton Burnfoot, Kelso, Roxburgh: First Prize, 15*l.*, for his 1 year, 3 months, 2 weeks-old: bred by himself.

William Purves, Linton Burnfoot: Second Prize, 10*l.*, for his 1 year, 3 months, 2 weeks-old; bred by himself.

Richard Tweedie, the Forest, Catterick: the *Reserve Number*, to his 1 year, 3 months, 2 weeks-old; bred by himself; sire, "Sir Samuel."

Oxfordshire Downs—Shearling Rams.

John Treadwell, Upper Winchendon, Aylesbury: First Prize, 20*l.*, for his about 1 year, 4 months, 2 weeks-old; bred by himself.

George Wallis, Old Shifford, Bampton, Faringdon: Second Prize, 10*l.*, for his 1 year, 5 months, 2 weeks-old; bred by himself.

George Wallis, Old Shifford: Third Prize, 5*l.*, to his 1 year, 5 months, 2 weeks-old; bred by himself.

The Duke of Marlborough, K.G., of Blenheim Palace, Woodstock, Oxon: the *Reserve Number*, to his 1 year, 4 months, 2 weeks-old; bred by himself.

Oxfordshire Downs—Rams of any other age.

JOHN TREADWELL, Upper Winchenden, Aylesbury: FIRST PRIZE, 20*l.*, for "Guildford," about 3 years, 4 months, 2 weeks-old; bred by himself.

GEORGE WALLIS, Old Shifford, Bampton, Faringdon: SECOND PRIZE, 10*l.*, for his 3 years, 5 months, 2 weeks-old; bred by himself.

A. F. MILTON DRUCE, Twelve Acres, Eynsham: THIRD PRIZE, 5*l.*, for his 2 years, 5 months-old; bred by himself.

FREDERICK STREET, Harrowden House, Bedford: the *Reserve Number*, to his 3 years, 5 months-old; bred by himself.

Oxfordshire Downs—Pens of Five Shearling Ewes.

CHARLES HOWARD, Biddenham, Bedford: FIRST PRIZE, 15*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

A. F. MILTON DRUCE, Twelve Acres, Eynsham, Oxon: SECOND PRIZE, 10*l.*, for his 1 year, 5 months-old; bred by himself.

CHARLES HOWARD, Biddenham, Bedford: the *Reserve Number*, to his 1 year, 4 months, 2 weeks-old; bred by himself.

Long Wools of any Breed—Pens of Twenty-five Shearling Gimmers of the same flock.

JOHN PEARS, Mere, Lincoln: FIRST PRIZE, 25*l.*, for his (Lincolns) 1 year, 4 months-old; bred by himself.

CHARLES CLARKE, Ashby-de-la-Launde, Sleaford, Lincolnshire: SECOND PRIZE, 15*l.*, for his (Lincolns) 1 year, 4 months-old; bred by himself.

EDWARD JOHN HOWARD, Nocton Rise, Nocton, Lincoln: THIRD PRIZE, 10*l.*, for his (Lincolns) 1 year, 3 months, 2 weeks-old; bred by himself.

JOHN BYRON, Kirkby Green, Sleaford, Lincolnshire: the *Reserve Number*, to his (Lincolns) 1 year, 3 months-old; bred by himself.

Southdowns—Shearling Rams.

WILLIAM RIGDEN, Hove, Brighton, Sussex: FIRST PRIZE, 20*l.*, for his 1 year, 4 months-old; bred by himself.

FRANCIS JOHN SAVILE FOLJAMBE, M.P., Osberton Hall, Worksop, Notts: SECOND PRIZE, 10*l.*, for his 1 year, 4 months-old; bred by himself.

JEREMIAH JAMES COLMAN, M.P., Carrow House, Norwich: THIRD PRIZE, 5*l.*, for "Governor," 1 year, 4 months, 2 weeks-old; bred by himself; sire, "Young Bury."

H.R.H. THE PRINCE OF WALES, K.G., Sandringham, King's Lynn, Norfolk: the *Reserve Number*, to his 1 year, 4 months-old; bred by His Royal Highness.

Southdowns—Rams of any other Age.

WILLIAM RIGDEN, Hove, Brighton, Sussex: FIRST PRIZE, 20*l.*, for his 3 years, 4 months-old; bred by himself.

WILLIAM RIGDEN, Hove: SECOND PRIZE, 10*l.*, for his 3 years, 4 months-old; bred by himself.

LORD WALSINGHAM, Merton Hall, Thetford: THIRD PRIZE, 5*l.*, for his 2 years, 4 months-old; bred by himself.

H.R.H. THE PRINCE OF WALES, K.G., Sandringham, King's Lynn: the *Reserve Number*, to his 2 years, 4 months-old; bred by His Royal Highness.

Southdowns—Pens of Five Shearling Ewes.

LORD WALSINGHAM, Merton Hall, Thetford: FIRST PRIZE, 15*l.*, for his 1 year, 4 months-old, bred by himself.

THE DUKE OF RICHMOND, K.G., Goodwood, Chichester: SECOND PRIZE, 10*l.*, for his 1 year, 5 months-old; bred by himself.

THE DUKE OF RICHMOND, K.G., Goodwood, Chichester: THIRD PRIZE, 5*l.*, for his 1 year, 5 months-old; bred by himself.

LORD SONDES, Elmham Hall, Dereham, Norfolk: the *Reserve Number*, to his 1 year, 4 months-old; bred by himself.

Shropshires—Shearling Rams.

LORD CHESHAM, Latimer, Chesham, Bucks: FIRST PRIZE, 20*l.*, for his 1 year, 2 months, 3 weeks-old; bred by himself.

SARAH BEACH, The Hattons, Brewood, Staffordshire: SECOND PRIZE, 10*l.*, for her 1 year, 3 months, 3 weeks-old; bred by herself.

JOHN COXON, Freeford Farm, Lichfield, Staffs.: THIRD PRIZE, 5*l.*, for his 1 year, 3 months, 2 weeks-old; bred by himself.

CHARLES BYRD, Littywood, Stafford: the *Reserve Number*, to his 1 year, 4 months-old; bred by himself.

Shropshires—Rams of any other Age.

EDWARD CRANE, Shrawardine, Shrewsbury: FIRST PRIZE, 20*l.*, for his 3 years, 3 months, 1 week-old; bred by himself; sire, "Caractacus;" sire of dam, "Celebrity."

THOMAS FENN, Stonebrook House, Ludlow, Salop: SECOND PRIZE, 10*l.*, to "Ensdon Hero," 2 years, 3 months, 1 week-old; bred by himself; sire, "Kingcraft;" sire of dam, "Novelty."

JOSEPH PULLEY, Lower Eaton, Hereford: THIRD PRIZE, 5*l.*, for "Dorchester Hero," 2 years, 3 months, 2 weeks-old; bred by Lord Chesham, Latimer, Chesham; sire, Mansell's "No. 8;" sire of dam, "Milton."

SARAH BEACH, The Hattons, Brewood, Penkridge, Staffs: the *Reserve Number*, to her 3 years, 4 months-old; bred by herself.

Shropshires—Pens of Five Shearling Ewes.

LORD CHESHAM, Latimer, Chesham: FIRST PRIZE, 15*l.*, for his 1 year, 2 months, 3 weeks-old; bred by himself.

JOHN HANBURY BRADBURN, Pipe Place, Lichfield: SECOND PRIZE, 10*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

JOHN HANBURY BRADBURN: THIRD PRIZE, 5*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

SARAH BEACH, the Hattons, Brewood, Penkridge; the *Reserve Number*, to her 1 year, 3 months, 2 weeks-old; bred by herself.

Hampshire and other Short Wools—Shearling Rams.

ALFRED MORRISON, Fonthill House, Tisbury, Wilts: FIRST PRIZE, 10*l*., for his (Hampshire Down) 1 year, 4 months, 2 weeks-old; bred by himself.

ALFRED MORRISON, SECOND PRIZE, 5*l*., for his (Hampshire Down) 1 year, 4 months, 3 weeks-old; bred by himself.

JAMES RAWLENCE, Bulbridge, Wilton, Salisbury: the *Reserve Number*, to his (Hampshire Down) 1 year, 5 months, 2 weeks-old; bred by himself.

Hampshire and other Short Wools—Rams of any other Age.

JAMES RAWLENCE, Bulbridge, Wilton: FIRST PRIZE, 10*l*., for his (Hampshire Down) 2 years, 5 months, 2 weeks-old; bred by himself.

ALFRED MORRISON, Fonthill House, Tisbury, Wilts: SECOND PRIZE, 5*l*., for his (Hampshire Down) 3 years, 4 months-old; bred by himself.

JAMES RAWLENCE, Bulbridge: the *Reserve Number*, to his (Hampshire Down), 3 years, 5 months, 2 weeks-old; bred by himself.

Hampshire and other Short Wools—Pens of Five Shearling Ewes.

JAMES RAWLENCE, Bulbridge: FIRST PRIZE, 10*l*., for his (Hampshire Down) 1 year, 5 months, 2 weeks-old; bred by himself.

JAMES RAWLENCE, Bulbridge: SECOND PRIZE, 5*l*., for his (Hampshire Down) 1 year, 5 months, 2 weeks-old; bred by himself.

Cheviots—Shearling Rams.

THOMAS ELLIOT, Hindhope, Jedburgh, N.B.: FIRST PRIZE, 10*l*., for his 1 year, 3 months-old; bred by himself.

THOMAS ELLIOT, Hindhope: SECOND PRIZE, 5*l*., for his 1 year, 3 months-old; bred by himself.

ROBERT SHORTREED, Attonburn, Kelso, N. B.: the *Reserve Number*, to his 1 year, 3 months-old; bred by himself.

Cheviots—Rams of any other Age.

THOMAS ELLIOT, Hindhope: FIRST PRIZE, 10*l*., for his 3 years, 3 months-old; bred by himself.

THOMAS ELLIOT, Hindhope: SECOND PRIZE, 5*l*., for his 2 years, 3 months-old; bred by himself.

JOHN ROBSON, Bymess, Rochester, Northumberland: the *Reserve Number*, to "Highland Chief," 3 years, 4 months-old; bred by himself.

Cheviots—Pens of Five Ewes.

THOMAS ELLIOT, Hindhope: FIRST PRIZE, 10*l*., for his various ages; bred by himself.

ROBERT SHORTREED, Attonburn, Kelso, N.B.: SECOND PRIZE, 5*l*., for his 1 year, 3 months-old; bred by himself.

Blackfaced Mountain—Shearling Rams.

CHRISTOPHER ARMSTRONG, Ashgill Side, Alston, Cumberland: FIRST PRIZE, 10*l*., for "Champion," 1 year, 3 months-old; bred by himself.

ALEXANDER WEARING LONG, Mint Cottage, Kendal: SECOND PRIZE, 5*l.*, for "Moses," 1 year, 3 months-old; bred by himself; sire, "Sampson."

Blackfaced Mountain—Rams of any other Age.

CHRISTOPHER ARMSTRONG, Ashgill Side, Alston, Cumberland: FIRST PRIZE, 10*l.*, for "Mountain Heather," 2 years, 3 months-old; bred by himself.

CHARLES H. WILSON, Rigmaden, Kirkby Lonsdale, Westmoreland: SECOND PRIZE, 5*l.*, for "Fan," 4 years-old; bred by Mr. A. W. Long, Mint Cottage, Kendal.

CHARLES H. WILSON, Rigmaden: the *Reserve Number*, to "Peter," 4 years-old; bred by Mr. A. W. Long.

Blackfaced Mountain—Pens of Five Ewes.

GEORGE CRAWTHERS, Gale Hall, Penrith, Cumberland: FIRST PRIZE, 10*l.*, for his 1 year, 3 months-old; bred by himself.

ALEXANDER WEARING LONG, Mint Cottage, Kendal: SECOND PRIZE, 5*l.*, for his 1 year, 3 months-old; bred by himself.

Mountain Sheep—Shearling Rams.

BENJAMIN DOBSON, Brook Street, Ilkley, Yorkshire: FIRST PRIZE, 10*l.*, for his (Lonk) 1 year, 3 months-old; bred by himself.

Mountain Sheep—Rams of any other Age.

BENJAMIN DOBSON, Brook Street, Ilkley: FIRST PRIZE, 10*l.*, for "Young King" (Lonk), 3 years, 3 months, 1 week-old; bred by Mr. Joseph Green, Keighley.

CHRISTOPHER H. WILSON, High Park, Kendal: SECOND PRIZE, 5*l.*, for "Nero" (Herdwick), 9 years-old.

Mountain Sheep—Pens of Five Ewes.

BENJAMIN DOBSON, Brook Street, Ilkley: FIRST PRIZE, 10*l.*, for his (Lonk) various ages; bred by himself.

*Pens of Ten Shearling Wether Sheep of any Breed.**

FREDERICK JOHN PERCY CLARKE, North Ferriby Brough, Yorkshire: FIRST PRIZE, 10*l.*, for his (Leicesters) 1 year, 3 months-old; bred by himself.

THE EXECUTORS of the late EARL OF ZETLAND, Aske Hall, Richmond, Yorkshire: SECOND PRIZE, 5*l.*, for their (Shropshires) 1 year, 3 months, 2 weeks-old; bred by the late Earl of Zetland.

JAMES and WILLIAM MARTIN, Newmarket, Aberdeen: the *Reserve Number*, to their 1 year 3 months-old Cross Downs; bred by Mr. James Hay, Turves, Aberdeenshire.

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* Prizes given by the Hull Butchers.

PIGS.

Large White Breed—Boars above Twelve Months old.

Clement R. N. Beswick-Royds, Pyke House, Littleborough, Lancashire: First Prize, 10*l.*, for "Velocipede," 3 years, 3 days-old; bred by Mr. Henry Neild, Worsley, Manchester; sire, "Punch;" dam, "Lancashire Witch;" sire of dam, "Silverhair."

Richard Elmhirst Duckering, Northorpe, Kirton-Lindsey: Second Prize, 5*l.*, for "Cultivator 9th," 1 year, 10 months, 2 weeks, 1 day-old; bred by himself.

The Earl of Ellesmere, Worsley Hall, Manchester: the *Reserve Number*, to "Sultan;" age and breeder unknown.

Large White Breed—Boars above Six and not exceeding Twelve Months old.

John Garbutt, South Cave, Brough, Yorkshire: First Prize, 10*l.*, for "John Bull," 10 months, 3 weeks, 1 day-old; bred by himself; sire, "Gladiator;" dam, "Blue Mantle;" sire of dam, "King Tom."

Jacob Dove, Hambrook House, Hambrook, Gloucestershire: Second Prize, 5*l.*, for "Lord Hambrook," 8 months, 4 weeks-old; bred by himself; sire, "Jack;" dam, "Hambrook Beauty;" sire of dam, "Old Jack."

Richard Elmhirst Duckering, Northorpe, Kirton-Lindsey, Lincolnshire: the *Reserve Number*, to "Oscar," 10 months-old; bred by Exhibitor.

Large White Breed—Breeding Sows.

The Earl of Ellesmere, Worsley Hall, Manchester: First Prize, 10*l.*, for "Lancashire Witch," 2 years, 9 months, 1 week, 6 days-old, in-pig; bred by Mr. Peter Eden, of Salford, Lancashire; "sire, "Ranger;" dam, "Formosa."

John Garbutt, South Cave, Brough, Yorkshire: Second Prize, 5*l.*, for "Primrose," 3 years-old, in-pig; bred by Mr. R. E. Duckering, of Northorpe, Kirton-Lindsey; sire, "Hermit."

Matthew Walker, Stockley Park, Anslow, Burton-on-Trent: the *Reserve Number*, to "Thalia 2nd," 3 years, 7 months, 3 weeks, 5 days-old, in-pig; bred by himself; sire, "Forest Boy;" dam, "Thalia 1st;" sire of dam, "Robin Hood 1st."

Large White Breed—Pens of Three Breeding Sow Pigs.

Peter Eden, Cross Lane, Salford, Manchester: First Prize, 10*l.*, for his 7 months, 2 weeks, 5 days-old; bred by himself; sire, "Major;" dam, "Sunrise;" sire of dam, "Young Sampson."

Jacob Dove, Hambrook House, Hambrook, Gloucestershire; Second Prize, 5*l.*, for "Three Lilies," 7 months, 1 week, 4 days-old; bred by himself; sire, "Sailor;" dam, "York;" sire of dam, "Old Jack."

Richard Elmhirst Duckering, Northorpe, Kirton-Lindsey, Lincolnshire: the *Reserve Number*, to "Three Gems," 7 months, 3 weeks, 5 days-old; bred by himself.

Small White Breed—Boars above Twelve Months old.

George Mumford Sexton, Wherstead Hall, Ipswich, Suffolk: First Prize, 10*l.*, for "Disturbance," 1 year, 5 months, 2 weeks-old; bred by himself; sire, "Peter;" dam, "Commotion;" sire of dam, "Suffolk."

The Earl of Ellesmere, Worsley Hall, Manchester: Second Prize, 5*l.*, for "Peacock," 2 years, 10 months-old; bred by Mr. Peter Eden, Salford, Manchester; sire, "Young King;" dam, "Princess;" sire of dam, "Violet."

Clement R. N. Beswick-Royds, Pyke House, Littleborough, Lancashire: the *Reserve Number*, to "Hector," 2 years, 9 months, 2 weeks, 2 days-old; bred by Mr. Peter Eden, Salford, Manchester; sire, "Young King;" dam, "Sister to Prince;" sire of dam, "Old Prince."

Small White Breed—Boars above Six and not exceeding Twelve Months old.

Peter Eden, Cross Lane, Salford, Manchester: First Prize, 10*l.*, for "Punch," 10 months, 3 weeks, 2 days-old; bred by himself; sire, "Peacock;" dam, "Moss Rose;" sire of dam, "Young Prince."

Lord Rendlesham, Rendlesham Hall, Woodbridge: Second Prize, 5*l.*, for "Gay Lad," 11 months, 2 weeks, 3 days-old; bred by himself; sire, "The Emperor;" dam, "Julia;" sire of dam, "The Prince."

Richard Elmhirst Duckering, Northorpe, Kirton-Lindsey, Lincolnshire: the *Reserve Number*, to "Lord Lincoln," 11 months, 1 week, 6 days-old; bred by himself.

Small White Breed—Breeding Sows.

The Earl of Ellesmere, Worsley Hall, Manchester: First Prize, 10*l.*, for "Queen of the West," 1 year, 10 months-old, in-pig; bred by Mr. Peter Eden, of Salford, Manchester; sire, "King of the West;" dam, "Princess;" sire of dam, "Violet."

George Mumford Sexton, Wherstead Hall, Ipswich, Sussex: Second Prize, 5*l.*, for "Rivalry," 1 year, 2 months, 6 days-old, in-pig; bred by himself; sire, "Peter;" dam, "Miss Oxford."

Clement R. N. Beswick-Royds, Pyke House, Littleborough, Lancashire: the *Reserve Number*, to "Northern Princess," 2 years, 1 week, 1 day-old; bred by himself; sire, "Brutus 2nd;" dam, "Queen of the North;" sire of dam, "King Lear."

Small White Breed—Pens of Three Breeding Sow Pigs.

The Earl of Ellesmere, Worsley Hall, Manchester: First Prize, 10*l.*, for his 7 months, 1 week-old; bred by Mr. Peter Eden, of Salford, Manchester; sire, "Unique;" dam, "Sister to Peacock;" sire of dam, "King of the West."

The Earl of Ellesmere, Worsley Hall: Second Prize, 5*l.*, for his 6 months, 2 weeks, 1 day-old; bred by himself; sire, "Unique;" dam, "Princess 2nd;" sire of dam, "Young Prince."

William Parker, Golden Lion Hotel, Leeds Road, Bradford: the *Reserve Number*, to "Rose," "Dewdrop," and "Rose of Yorkshire," 7 months-old; bred by himself;" sire, "Grand Turk;" dam, "Moss Rose;" sire of dam, "Longback."

Small Black Breed—Boars above Twelve Months old.

GEORGE MUMFORD SEXTON, Wherstead Hall, Ipswich, Suffolk: FIRST PRIZE, 10*l.*, for "Doncaster," 1 year, 3 months, 1 week-old; bred by himself; sire, "Adventurer;" dam, "Sister to Reine;" sire of dam, "Blair Athol."

CLEMENT R. N. BESWICK-ROYDS, Pyke House, Littleborough, Lancashire: SECOND PRIZE, 5*l.*, for "Indian Chief," 2 years, 7 months, 1 day-old; bred by Mr. S. G. Stearn, Wickham Market; sire, "Kesgrave;" dam, "Duchess;" sire of dam, "East Suffolk Champion."

WILLIAM HOPE, V.C., Parsloes, Chadwell Heath, Essex: the *Reserve Number*, to "The Clerk," 1 year, 7 months, 1 week, 6 days-old; bred by himself; sire, "The Parson;" dam, "Aunt Hannah."

Small Black Breed—Boars above Six and not exceeding Twelve Months old.

GEORGE MUMFORD SEXTON, Wherstead Hall, Ipswich: FIRST PRIZE, 10*l.*, for "Marsworth," 11 months, 3 weeks, 1 day-old; bred by himself; sire, "Blair Athol;" dam, "Black Diamond Again;" sire of dam, "Butley Sambo."

GEORGE MUMFORD SEXTON, Wherstead Hall, Ipswich: SECOND PRIZE, 5*l.*, for "Kidbroke," 9 months, 3 weeks, 6 days-old; bred by himself; sire, "Gladiateur;" sire of dam, "Adventurer."

SAMUEL WOLTON, Butley Abbey, Wickham Market, Suffolk: the *Reserve Number*, to "Imperial," 11 months, 2 weeks, 3 days-old; bred by himself; sire, "Northy's Pride;" dam, "My Fancy;" sire of dam, "Nonpareil."

Small Black Breed—Breeding Sows.

JAMES KNOWLES, Wetherby House, Wetherby, Yorkshire: FIRST PRIZE, 10*l.*, for "Black Bess," about 2 years-old; bred by himself.

GEORGE MUMFORD SEXTON, Wherstead Hall, Ipswich: SECOND PRIZE, 5*l.*, for his 1 year, 2 months, 3 weeks, 6 days-old; bred by himself; sire, "Blair Athol;" sire of dam, "Adventurer."

SAMUEL WOLTON, Butley Abbey, Wickham Market, Suffolk: the *Reserve Number*, to "Miss Northy 2nd," 1 year, 6 months, 4 days-old; bred by himself; sire, "Northy's Pride;" dam, "Miss Northy;" sire of dam, "Negro."

Small Black Breed—Pens of Three Breeding Sow Pigs.

GEORGE MUMFORD SEXTON, Wherstead Hall, Ipswich: FIRST PRIZE, 10*l.*, for "Bound to Win," 7 months, 3 weeks, 2 days-old; bred by Exhibitor; sire, "Adventurer;" dam, "Sister to Achievement;" sire of dam, "Stockwell."

Berkshire Breed—Boars above Twelve Months old.

JOHN WHEELER, Long Compton, Shipston-on-Stour, FIRST PRIZE, 10*l.*, for "Sam," 1 year, 10 months, 1 week-old; bred by himself.

WILLIAM HEWER, Sevenhampton, Highworth, Wilts: SECOND PRIZE, 5*l.*, for "Cardiff Hero," 1 year, 11 months, 5 days-old; bred by himself; sire, "Exchange;" dam, "Hope;" sire of dam, "Sennington Lad 5th."

HEBER HUMFREY, Kingstone Farm, Shrivenham: the *Reserve Number*, to "Sir Dorchester Cardiff," 2 years, 2 weeks, 2 days-old; bred by himself; sire, "Leamington;" dam, "Idstonia;" sire of dam, "Rainbow."

Berkshire Breed—Boars above Six and not exceeding Twelve Months old.

WILLIAM HEWER, Sevenhampton, Highworth: FIRST PRIZE, 10*l*., for his 11 months, 1 week, 4 days-old; bred by himself; sire, "Wallace;" dam, "Handsome;" sire of dam, "Exchange."

RUSSELL SWANWICK, R. A. College Farm, Cirencester; SECOND PRIZE, 5*l*., for his 9 months, 2 weeks, 4 days-old; bred by himself; sire, "Othello;" dam, "Sally 6th."

HEBER HUMFREY, Kingstone Farm, Shrivenham, the *Reserve Number*, to "No. 410 M," 11 months, 3 days-old; bred by himself; sire, "No. 384 N;" dam, "Watch;" sire of dam, "No. 299 M."

Berkshire Breed—Breeding Sows.

ARTHUR STEWART, Saint Bridge Farm, Gloucester: FIRST PRIZE, 10*l*., for "Princess 2nd," 2 years, 3 months, 1 week, 4 days-old, in-pig; bred by himself; sire, "The Blacksmith;" dam, "Princess 1st;" sire of dam, "Sampson."

RUSSELL SWANWICK, R. A. College Farm, Cirencester: SECOND PRIZE, 5*l*., for his 1 year, 5 months, 2 weeks, 2 days-old, in-pig; bred by himself; sire, "Othello;" dam, "Stumpy 2nd."

THE MARQUIS OF AILESBURY, Savernake Forest, Marlborough: the *Reserve Number*, to "Wiltshire Rose," 1 year, 3 months, 1 week-old, in-pig; bred by himself; sire, "Savernake;" dam, "Irish Lady;" sire of dam, "Saddler."

Berkshire Breed—Pens of Three Breeding Sow Pigs.

WILLIAM HEWER, Sevenhampton, Highworth, Wiltshire: FIRST PRIZE, 10*l*., for his 7 months, 2 days-old; bred by himself; sire, "Wallace;" dam, "Faith;" sire of dam, "Sennington Lad 5th."

RUSSELL SWANWICK, R.A. College Farm, Cirencester: SECOND PRIZE, 5*l*., for his 7 months, 3 days-old; bred by himself; sire of dam, "S. V."

MATTHEW WALKER, Stockley Park, Anslow, Burton-on-Trent: the *Reserve Number*, to "Speck," "Sylph," "Syson," 7 months, 3 weeks, 6 days-old; bred by himself; sire, "Kingcraft;" dam, "Gipsy;" sire of dam, "Solicitor-General."

Other Breeds—Boars.

THE EARL OF ELLESMERE, Worsley Hall, Manchester, Lancashire: FIRST PRIZE, 10*l*., for "Duke of Lancaster," white (middle), 2 years, 9 months, 1 week 3 days-old; bred by Mr. Peter Eden, Salford, Manchester; sire, "Young Prince;" dam, "Lancashire Lass;" sire of dam, "King Lear 2nd."

THE EARL OF ELLESMERE, Worsley Hall: SECOND PRIZE, 5*l*., for "Pretender," white, with blue (middle), 1 year, 11 months, 3 days-old; bred by Mr. J. Mitchell, Hipperholme, Halifax, Yorkshire; sire, "Pretender;" dam, "Yorkshire Lass."

O HN BULLOCK, Swan Hotel, Idle, Leeds, Yorkshire: the *Reserve Number*, to "Peacock," white (middle), 1 year, 10 months, 2 weeks, 4 days-old; bred by himself; sire, "Bulliver;" dam, "Betty;" sire of dam, "Shadow."

Other Breeds—Breeding Sows.

The Earl of Ellesmere, Worsley Hall, Manchester: First Prize, 10*l.*, for "Grand Duchess," white (middle), 2 years-old, in-pig; bred by Mr. W. Hatton, Addingham, Leeds; sire, "Charlie;" dam, "Yorkshire Lass;" sire of dam, "Joseph 2nd."

Jonah Taylor, Ireby Mill, Ireby, Carlisle, Cumberland: Second Prize, 5*l.*, for "Betty," white, 2 years, 8 months-old; bred by Mr. Samuel Bird, Johnby, Penrith.

The Earl of Ellesmere, Worsley Hall: the *Reserve Number*, to "Lady Betty," white (middle), 2 years, 6 months-old, in-pig; bred by Mr. W. Parker, Golden Lion Hotel, Bradford; sire, "Prince;" dam, "Queen of Airedale;" sire of dam, "Long Back."

Other Breeds—Pens of Three Breeding Sow Pigs.

Richard Elmhirst Duckering, Northorpe, Kirton-Lindsey: First Prize, 10*l.*, for his white (middle), 7 months, 3 weeks, 1 day-old; bred by himself.

John Moir and Son, Garthdee, Aberdeen: Second Prize, 5*l.*, for their black and white, 6 months-old; bred by themselves.

IMPLEMENTS.

Wheel Ploughs, not exceeding 2 Cwt.

William Hunt, Leicester: First Prize, 10*l.*, for his Light Land Iron Plough; manufactured by himself.

William Ball and Son, Rothwell, Kettering: Second Prize, 5*l.*, for their Iron Plough; manufactured by themselves.

Wheel Ploughs, not exceeding 2½ Cwt.

William Ball and Son, Rothwell, Kettering: First Prize, 10*l.*, for their Iron Plough; manufactured by themselves.

William Hunt, Leicester: Second Prize, 5*l.*, for his General Purpose Iron Plough; manufactured by himself.

Wheel Ploughs, not exceeding 3 Cwt.

William Ball and Son, Rothwell, Kettering: First Prize, 10*l.*, for their Iron Plough; manufactured by themselves.

John Hodgson, Louth, Lincolnshire; Second Prize, 5*l.*, for his Strong Iron Plough; manufactured by himself.

Swing Ploughs, not exceeding 2½ Cwt.

J. D. Snowden, Doncaster: First Prize, 10*l.*, for his improved Swing Plough; manufactured by himself.

William Ball and Son, Rothwell, Kettering: Second Prize, 5*l.*, for their Iron Swing Plough; manufactured by themselves.

Double-Furrow Ploughs, not exceeding $3\frac{1}{2}$ *Cwt.*

G. W. Murray and Co., Banff Foundry, Banff, N.B.: First Prize, 10*l.*, for their Double-Furrow Plough; manufactured by themselves.

J. D. Snowden, Doncaster: Second Prize, 5*l.*, for his Double-Furrow Plough; manufactured by himself.

Double-Furrow Ploughs, not exceeding 5 Cwt.

G. W. Murray and Co., Banff Foundry, Banff, N.B.: First Prize, 10*l.*, for their Double-Furrow Plough; manufactured by themselves.

J. D. Snowden, Doncaster: Second Prize, 5*l.*, for his Double-Furrow Plough; manufactured by himself.

Subsoil Ploughs.

E. H. Bentall, Heybridge Works, Maldon, Essex: the Prize of 5*l.*, for his Subsoil Plough; manufactured by himself.

Subsoilers attached to Single-Furrow Ploughs, for ploughing and subsoiling at one operation.

William Ball and Son, Rothwell, Kettering: the Prize of 5*l.*, for their Iron Plough and Subsoiler combined; manufactured by themselves.

Subsoilers attached to Double-Furrow Ploughs, for ploughing and subsoiling at one operation.

Corbett and Peele, Perseverance Ironworks, Shrewsbury: the Prize of 5*l.*, for their combined Double-Furrow and Subsoil Plough; manufactured by themselves.

One-way Ploughs.

John Davey, Croft Hole, St. German's, Cornwall: the Prize of 5*l.*, for his Single-Furrow One-way Plough; and the Prize of 5*l.*, for his Double-Furrow One-way Plough; manufactured by himself.

Double Mouldboards or Ridging Ploughs, not exceeding $2\frac{1}{2}$ *Cwt.*

William Ball and Son, Rothwell, Kettering: the Prize of 5*l.*, for their Double Mouldboard Plough; manufactured by themselves.

G. W. Murray and Co., Banff Foundry, Banff, N.B.: Highly Commended, for their Drill or Ridging Plough; manufactured by themselves.

Paring Ploughs.

William Hunt, Leicester, the Prize of 5*l.*, for his Turf and Stubble Paring Plough; manufactured by himself.

Pulverizers.

Mellard's Trent Foundry, Rugeley: the Prize of 5*l.*, for their Revolving Mouldboard Plough; manufactured by themselves.

Light Harrows.

WILLIAM ASHTON, Boston Road, Horncastle: FIRST PRIZE, 10*l.*, for his Set of Light Seed Harrows; manufactured by himself.

WILLIAM HUNT, Leicester: SECOND PRIZE, 5*l.*, for his Set of Light General-purpose Harrows; manufactured by himself.

Heavy Harrows.

WILLIAM ASHTON, Boston Road, Horncastle: FIRST PRIZE, 10*l.*, for his Set of Iron Harrows for Heavy Land; improved and manufactured by himself.

BENJAMIN REID and Co., Bon-Accord Works, Aberdeen: SECOND PRIZE, 5*l.*, for their improved Heavy Harrows; manufactured by themselves.

Chisel Harrows.

WILLIAM ASHTON, Boston Road, Horncastle: FIRST PRIZE, 10*l.*, for his Chisel-toothed Harrow; invented by J. Seel; manufactured by himself.

SHARMAN and LADBURY, Melton Mowbray: SECOND PRIZE, 5*l.*, for their Diagonal Oscillating Drag-Harrow; manufactured by themselves.

CHARLES CLAY, Stennard Works, Wakefield: HIGHLY COMMENDED for his Chisel Harrow; manufactured by himself.

Chain Harrows.

CAMBRIDGE and PARHAM, St. Philip's Ironworks, Bristol: the PRIZE of 5*l.*, for their Chain Harrow; invented by W. C. Cambridge; manufactured by themselves.

HENRY DENTON, Wolverhampton: COMMENDED, for his Chain Harrow and Carriage.

WILLIAM HUNT, Leicester: COMMENDED, for his Set of Spike Chain Harrows; manufactured by himself.

CAMBRIDGE and PARHAM, Bristol: COMMENDED, for their Combined Tine and Chain Harrow; invented by W. C. Cambridge; manufactured by themselves.

Drag Harrows.

E. PAGE and Co., Bedford: the PRIZE of 5*l.*, for their Adjustable-Tooth Drag Harrows; manufactured by themselves.

Other Harrows.

THOMAS HUNTER, Maybole, N. B.: the PRIZE of 5*l.*, for his Set of Dickson's Patent Harrows for Harrowing Turnip Drills; manufactured by himself.

Light Rollers.

BARFORD and PERKINS, Queen Street Ironworks, Peterborough: FIRST PRIZE, 10*l.*, for their Wrought Iron Adjustable Water-Ballast Field Roller; manufactured by themselves.

The BEVERLEY IRON and WAGGON COMPANY, Beverley: SECOND PRIZE, 5*l.*, for their plain Field Roller; manufactured by themselves.

Barford and Perkins, Peterborough: Highly Commended, for their Wrought Iron Double-Cylinder Field Roller; manufactured by themselves.

William Hunt, Leicester: Commended, for his Wrought Iron Three-Cylinder Self-lubricating Field Roller; manufactured by himself.

Heavy Rollers.

Barford and Perkins, Peterborough: First Prize, 10*l.*, for their Wrought Iron Adjustable Water-Ballast Field Roller; manufactured by themselves.

The Beverley Iron and Waggon Company, Beverley: Second Prize, 5*l.*, for their Plain Field Roller; manufactured by themselves.

William Crosskill and Sons, Beverley: Highly Commended, for their plain Field Roller; manufactured by themselves.

Clod Crushers.

The Beverley Iron and Waggon Company, Beverley: First Prize, 10*l.*, for their Clod Crusher, with self-cleaning action; manufactured by themselves.

William Croskill and Sons, Beverley: Second Prize, 5*l.*, for their Self-cleansing Clod Crusher; manufactured by themselves.

Barford and Perkins, Peterborough: Highly Commended, for their Press-Wheel Steerage Frame Cambridge Clod Crusher; manufactured by themselves.

Other Rollers or Clod Crushers.

Brigham and Co., Berwick-on-Tweed: the Prize of 10*l.*, for their Drill Roller; manufactured by themselves.

Cultivating Implements for Light Land.

Charles Clay, Stennard Works, Wakefield; First Prize, 15*l.*, for his Cultivator; manufactured by himself.

Coleman and Morton, Chelmsford: Second Prize, 10*l.*, for their Cultivator; manufactured by themselves.

Cultivating Implements for Heavy Land.

Charles Clay, Wakefield: First Prize, 15*l.*, for his Cultivator and Broadshare; manufactured by himself.

William Hunt, Leicester: Second Prize, 10*l.*, for his Cultivator, Grubber, and Scarifier; manufactured by himself.

Coleman and Morton, Chelmsford: Highly Commended, for their Cultivator manufactured by themselves.

Broadshares.

Charles Clay, Wakefield: the Prize of 10*l.*, for his Cultivator and Broadshare; manufactured by himself.

Coleman and Morton, Chelmsford: Highly Commended.

Other Cultivators or Scarifiers.

CHARLES CLAY, Wakefield: FIRST PRIZE, 10*l.*, for his Cultivator and Broadshare and Drag Harrow; manufactured by himself.

WILLIAM BALL and SON, Rothwell, Kettering: SECOND PRIZE, 5*l.*, for their Cultivator; manufactured by themselves.

Stacking Machines.

WILLIAM TASKER and SONS, Andover: the PRIZE of 25*l.*, for their Folding 4-wheel Elevator; manufactured by themselves.

WALLIS and STEVENS, Basingstoke: HIGHLY COMMENDED, for their Slow-Motion Automatic Folding Elevator; manufactured by themselves.

BARFORD and PERKINS, Peterborough: COMMENDED, for their Combined Hay, Corn, and Straw Elevator; manufactured by themselves.

JAMES COULTAS, Grantham: COMMENDED, for his Straw Elevator; manufactured by himself.

HOLMES and SONS, Norwich: COMMENDED, for their Combined Stacking Machine; manufactured by themselves.

MISCELLANEOUS AWARDS.

SILVER MEDALS.

BARFORD and PERKINS, Peterborough: for their Patent wrought-iron Link-Motion to Road Gear on Traction Engine.

JAMES COULTAS, Grantham: for his Wright's Potato Planter.

GEORGE CHEAVIN, Boston, Lincolnshire: for his Patent Rapid Water Filter, for Agricultural Purposes.

SAMUEL WILKERSON, jun., Basingbourn, Royston: for his Machine for Shooting Corn from one sack to another.

HEAD, WRIGHTSON, and Co., Stockton-on-Tees: for Moore's Patent Pulley Block.

DAVEY, PAXMAN, and Co., Colchester: for their Apparatus for Heating Water in Tank of Traction Engines by Exhaust Steam Pipe.

KIMBALL and MORTON, Glasgow and Dundee, N.B.: for their Sack-Sewing Machine.

AGRICULTURAL EDUCATION.

Examination Papers, 1873.

EXAMINATION IN AGRICULTURE.

MAXIMUM NUMBER OF MARKS, 200. PASS NUMBER, 100.

Tuesday, April 22nd, from 10 *a.m. till* 1 *p.m.*

1. What considerations would influence you in the selection of a farm this year?

2. Is Lady-day or Michaelmas the best time of entering an occupation of about equal parts of grass and arable land? State reasons for your decision.

3. What principles should be kept in view in the breeding of stock?

4. Describe the most suitable method of cropping for light, medium, and strong soils.

5. Supposing you occupy a light land farm of 500 acres, four-fifths of which is arable, and one-fifth of rather inferior grass. What quantity and description of stock should you keep, and when would you dispose of it?

6. Describe the cultivation for roots on the before-mentioned farm, assuming the land to be moderately clean, and give the cost of each operation in detail.

7. Estimate the cost of securing the grain harvest on this farm.

8. Describe the buildings necessary for the most profitable occupation of such a farm.

9. Mention the different methods of making farmyard manure, and show the difference in the consumption of straw under each process; also compare their relative value, and state the effect of corn and cake feeding upon this question.

10. Describe the management, and give the cost, of keeping a flock of 200 breeding ewes from harvest time until after the lambing season.

The vivâ voce *examination commences at* 2 *o'clock.*

EXAMINATION IN CHEMISTRY.

MAXIMUM NUMBER OF MARKS, 200. PASS NUMBER, 100.

I. GENERAL CHEMISTRY.

Wednesday, April 23rd, from 10 a.m. till 1 p.m.

1. Describe the elements hydrogen and nitrogen. State some of the substances in which they occur in nature, and how they are combined in those substances. In what proportions by weight and by volume do they unite with each other? By what characters may they be distinguished from other elements and compounds?

2. Point out the essential characters in which chemical compounds differ from mechanical mixtures, and illustrate your reply by the case of atmospheric air and other examples.

3. Describe methods of preparing common hydrochloric and phosphoric acids, and explain the chemistry of the processes.

4. If 100 measures of a solution of common salt require 34 measures of a solution of silver nitrate, containing one-tenth of a grain in each measure, for the complete precipitation of all the chlorine, find the quantity of salt in each measure of the solution. (N : O : Cl : Na : Ag = 14 : 16 : 35·5 : 23 : 108).

5. Explain what is meant by diffusion of gases, and the importance of this property of gases in respect to respiration. State the experimental law as to the rates of diffusion of gases into one another through porous divisions. What will be the relative rates of diffusion of H^3N and CO^2 into O?

6. Describe a method of preparing caustic soda, and explain the chemistry of the process. State the re-actions of caustic soda with iron (ferric) chloride, copper sulphate, and ammonium nitrate respectively. How can caustic soda be distinguished from sodium carbonate?

7. A solution of ammonia being given, it is required to find the proportion of ammonia to water: explain how to do it.

8. Explain the nature of the chemical changes which occur in the ordinary fermentation of beer and bread. State the circumstances necessary to the fermentation, and some of the means by which the progress of such fermentation may readily be stopped.

9. State the chemical constitution of soaps. Explain why soap curdles in hard water.

10. What are the elements of albumen? In what sort of organised bodies and in what parts of them does albumen occur? In what substance does it dissolve, and by what means can it be precipitated? How is it distinguished from gelatine?

II. Agricultural Chemistry.

Wednesday, April 23rd, from 2 p.m. till 5 p.m.

1. What is the general composition of peaty soils? Mention the best means for reclaiming peat-bogs?

2. Describe the chemical changes which take place in paring and burning?

3. Describe the chemical and physical effects of ploughing and subsoiling. Should all land be ploughed deep?

4. What do you understand by permanent fertility of the land? Is it possible to increase the permanent fertility of soils?

5. Mention the constituents upon the presence of which the productive powers of soils mainly depend, and show in what way the continuous growth of grain-crops exhausts all soils more or less rapidly.

6. Is it possible or advisable to grow wheat after wheat for a number of years in succession without deterioration of the land; under what circumstances and by what means may such a course of cropping be pursued, and under what circumstances should it not be attempted?

7. What is the general composition of sewage manures, obtained by precipitating town-sewage with lime? State the agricultural and commercial value of such sewage manures.

8. A farmer requires nitrate of soda, mineral phosphate, dissolved bones, bone dust, and Peruvian guano. How should he proceed in order to procure these manures of the best quality at the lowest price?

9. What is the composition and agricultural and commercial value of gas-lime; gas-water; gas-tar? How should gas-lime and gas-water be used in agriculture?

EXAMINATION IN MECHANICS AND NATURAL PHILOSOPHY.

Maximum Number of Marks, 200. Pass Number, 100.

Thursday, April 24th, from 10 a.m. till 1 p.m.

1. What is meant when it is said that one body has twice the density of another body?

2. Forces of 3, 4, and 6 units act on a point, and keep it at rest; show by a diagram exactly how they must be adjusted. Why could not forces of 9, 17, and 7 units balance each other under any circumstances?

3. What is the relation between the power and the weight in the screw press, on the supposition that there is no friction between its parts? A screw makes one turn to the inch, and is worked by an arm 4 feet long: what force at the end of the arm would, upon the above supposition, compress the substance within the press with a force of 3 tons?

4. An agent lifts 6 tons through a height of 77 feet in 0·75 of a minute: What is its horse-power? What is meant when it is said that an agent works with 1 horse-power?

5. A body moving at the rate of 1200 ft. a minute is brought to rest by a constant force in 5 seconds: how far did the body move during each of those 5 seconds successively?

6. A cup weighs 6 oz., when full of water it weighs 15 oz., when full of spirit it weighs $13\frac{1}{2}$ oz.: what is the specific gravity of the spirit? Why would this determination be inexact? Describe briefly an instrument by which the same principle can be made to give an exact determination.

7. Describe briefly the cupped leather collar and its use in a hydraulic press.

8. State the relation between the pressure and temperature of a given volume of air. A quantity of air at a temperature of 32° Fahr., and under a pressure of 30 inches of mercury, is inclosed in an air-tight vessel: by how many degrees must the temperature be raised in order that its pressure against the sides of the vessel may equal that of 35 inches of mercury.

9. Explain the principle and use of a fly-wheel in an ordinary steam-engine.

EXAMINATION IN MENSURATION AND LAND SURVEYING.

Maximum Number of Marks, 100. Pass Number, 50.

Thursday, April 24th, from 2 p.m. till 5 p.m.

1. What is the number of feet in a chain, and of square chains and square yards in an acre? A square piece of ground contains 30 acres; how many yards and how many chains are there in one side of it?

2. If cabbages were planted 16 in. apart in all directions, how many would there be in a square field of 10 acres? How many would there be if they were planted 16 in. apart in the rows, and the rows 16 in. apart?

3. Explain how you would divide a triangular field into two equal parts, by means of a straight line drawn through a given point on one side.

4. A straight flight of stairs rises altogether 14 feet, each riser is 7 inches high, each tread 11 inches wide; how many yards are needed to carpet it, allowing a foot at each end?

5. In a common hipped roof, the eaves are 32 feet and 50 feet long respectively; the pitch is 2 horizontal to 1 vertical; how many squares of slate will cover it?

6. A cubic inch of iron weighs 4 oz.; what is the weight of the tire of a wheel 5 feet in diameter, 3 inches wide, and $\frac{1}{4}$ inch thick?

7. Two trees are at opposite sides of a pond; there is plenty of open ground about the pond, and you can freely approach the trees; you are provided with ropes, pickets, and tape; explain how to determine the distance between the trees by any method that does not involve the measurement or prolongation of a short line.

8. A road 3 miles long slopes up at an angle of 3° 15′ 21″; find the vertical height of the upper above the lower end of the road.

9. A base AB is measured 371 feet long; P is a point in the same horizontal plane with the base; the angle PAB is 62° 18′, and PBA is 97° 43′; find the distance PA, and distance from A of the point where a perpendicular drawn from P cuts AB or AB produced.

EXAMINATION IN BOOKKEEPING.

Maximum Number of Marks, 200. Pass Number, 100.

Friday, April 25th, from 10 *a.m. till* 1 *p.m.*

Journalise and post into a ledger, in proper technical form and language, the following series of facts and transactions; and from such ledger make out a Trial Balance, a Profit and Loss Account, and a Balance Sheet:—

Liabilities and Assets of A. Briant, Seed Merchant, 31st December, 1872.

	£	s.	d.	£	s.	d.
Liabilities.						
Amount due P. Taylor				135	14	6
Rent (one quarter)				25	0	0
Bills payable—						
Due 28th Jan., 1873	160	0	0			
„ 4th Feb., 1873	210	0	0			
				370	0	0

	£	s.	d.
Assets.			
Stock in hand	1345	13	8
Carts, horses, &c.	150	0	0
Cash in hand	20	4	9
Stock of hay	20	0	0

His transactions during the month of January, 1873, were as follows :

1873.						£	s.	d.
Jan.	1.	Sold to B. Andrews seeds for				235	16	8
,,	,,	Drew a bill on Andrews for ..	220	0	0			
,,	,,	And received from him in cash	15	16	8			
						235	16	8
,,	4.	Discounted B. Andrews' bill with the United Discount Corporation, and received for the same in cash				217	18	0
,,	,,	Sold seeds for cash				29	13	6
,,	,,	Paid to P. Taylor				50	0	0
,,	6.	Sold seeds to J. Bailey				218	4	3
,,	8.	Paid rates and taxes				3	14	8
,,	10.	Bought of J. Mildred seeds for				356	0	0
,,	15.	Paid rent due Xmas last				25	0	0
,,	20.	Bought hay for use in stables				13	3	4
		Paid for same	12	16	8			
		Allowed for discount	0	6	8			
						13	3	4
,,	23.	Received of J. Bailey cash				197	10	0
,,	,,	Allowed to him for discount				20	14	3
,,	28.	Received invoice of grain from J. Duncan, of New York, on consignment				450	0	0
,,	,,	Accepted J. Duncan's draft, due 21st April, for				400	0	0
,,	,,	Paid bill due this day				160	0	0
,,	29.	Paid expenses on above consignment				12	4	0
,,	30.	Sold J. Duncan's grain to P. Smith				503	8	0
,,	,,	Commission on selling the same				12	11	8
,,	,,	Paid R. Sims on account of J. Duncan ..				78	12	4
,,	,,	Paid Fire Insurance				8	0	0
,,	31.	Paid clerk one month's salary				12	10	0
,,	,,	Paid wages during this month				8	0	0
,,	,,	Drawn out for private expenses				35	0	0
,,	,,	Stock of seeds on hand				1923	13	8
,,	,,	Carts and horses, valued at				142	10	0
,,	,,	Stock of hay				25	0	0

London, 31*st March,* 1873.

EXAMINATION IN GEOLOGY.

Maximum Number of Marks, 100. Pass Number, 50.

Friday, April 25th, from 2 p.m. till 5 p.m.

1. Define the terms,—Azoic, Palæozoic, Mesozoic, and Cainozoic.

2. Give a list of the groups of stratified rocks in chronological order.

3. Explain the action of Rain, Springs, and Frosts, as geological agents.

4. Upon what geological formations are the chief clay vales of England situated? Point out any differences in their relative agricultural character.

5. Enumerate the substances used as mineral manures, and state the geological formations from which they are obtained in England.

6. Give the sub-divisions of the cretaceous rocks, state their mineral characters, and the nature of the soils derived from them.

7. State the geological structure of a district best adapted for obtaining a supply of water by means of Artesian wells.

8. Briefly explain the terms,—Marine and River Alluvium, Fenlands, Peat-bogs, and give examples of their occurrence.

9. In what English counties are the Oolitic rocks largely developed?

10. Tabulate in descending order the Palæozoic limestones, and mention some of their characteristic fossils.

11. Give the approximate composition and physical characters of the chief minerals which enter into the composition of the igneous rocks.

12. Name the specimens on the table.

EXAMINATION IN BOTANY.

[It is expected that Eight Questions at least be answered.]

MAXIMUM NUMBER OF MARKS, 100. PASS NUMBER, 50.

Saturday, April 26th, from 10 *a.m. till* 1 *p.m.*

1. What is osmose?

2. Explain the difference between the ovule and the seed.

3. Distinguish between wood tissue and vascular tissue.

4. How can the wood of a gymnosperm be distinguished from that of an exogenous angiosperm?

5. Explain the provision for extending the surface of absorption in the roots of plants.

6. What are the conditions requisite for the germination of a seed?

7. Give the principal groups into which cryptogamous plants are arranged, with their distinguishing characters, and an example of each.

8. Trace the development of the spore of the fern from its germination till the young fern is produced.

9. What are the principal elements of the food of plants, whence are they obtained, and by what organs are they appropriated?

10. How does the plant benefit from artificial manures?

11. Give the scientific names and natural orders of six grasses or other plants likely to be found in a natural meadow.

12. Describe in a systematic method the plants marked A B and C.

EXAMINATION IN ANATOMY AND ANIMAL PHYSIOLOGY.

MAXIMUM NUMBER OF MARKS, 100. PASS NUMBER, 50.

Saturday, April 26th, from 2 p.m. till 5 p.m.

1. State in general terms, the structure of the larynx, windpipe, bronchial tubes, and lungs of the ox.

2. Describe the physiology of respiration, with especial reference to the chemical changes which take place in the blood, and also to the different conditions of the air contained in the lungs and that which passes in and out of these organs in the acts of inspiration and expiration.

MEMORANDA.

Address of Letters.—The Society's office being situated in the postal district designated by the letter W, members, in their correspondence with the Secretary, are requested to subjoin that letter to the usual address.

General Meeting in London, in December, 1873.

General Meeting in London, May 22, 1874, at 12 o'clock.

Meeting at Bedford, July, 1874.

Monthly Council (for transaction of business), at 12 o'clock on the first Wednesday in every month, excepting January, September, and October: open only to Members of Council and Governors of the Society.

Adjournments.—The Council adjourn over Passion and Easter weeks, when those weeks do not include the first Wednesday of the month; from the first Wednesday in August to the first Wednesday in November; and from the first Wednesday in December to the first Wednesday in February.

Office Hours.—10 to 4. On Saturdays, from the Council Meeting in August until the Council Meeting in April, 10 to 2.

Diseases of Cattle, Sheep, and Pigs.—Members have the privilege of applying to the Veterinary Committee of the Society, and of sending animals to the Royal Veterinary College on the same terms as if they were subscribers to the College.—(A statement of these privileges will be found in the Appendix.)

Chemical Analysis.—The privileges of Chemical Analysis enjoyed by Members of the Society will be found stated in the Appendix to the present volume.

Botanical Privileges.—The Botanical Privileges enjoyed by Members of the Society will be found stated in the Appendix to the present volume.

Subscriptions.—1. Annual.—The subscription of a Governor is £5, and that of a Member £1, due in advance on the 1st of January of each year, and becoming in arrear if unpaid by the 1st of June. 2. For Life.—Governors may compound for their subscription for future years by paying at once the sum of £50, and Members by paying £10. Governors and Members who have paid their annual subscription for 20 years or upwards, and whose subscriptions are not in arrear, may compound for future annual subscriptions, that of the current year inclusive, by a single payment of £25 for a Governor, and £5 for a Member.

Payments.—Subscriptions may be paid to the Secretary, in the most direct and satisfactory manner, either at the Office of the Society, No. 12, Hanover Square, London, W., or by means of post-office orders, to be obtained at any of the principal post-offices throughout the kingdom, and made payable to him at the Vere Street Office, London, W.; but any cheque on a banker's or any other house of business in London will be equally available, if made payable on demand. In obtaining post-office orders care should be taken to give the postmaster the correct initials and surname of the Secretary of the Society (H. M. Jenkins), otherwise the payment will be refused to him at the post-office on which such order has been obtained; and when remitting the money-orders it should be stated by whom, and on whose account, they are sent. Cheques should be made payable as drafts on demand (not as bills only payable after sight or a certain number of days after date), and should be drawn on a London (not on a local country) banker. When payment is made to the London and Westminster Bank, St. James's Square Branch, as the bankers of the Society, it will be desirable that the Secretary should be advised by letter of such payment, in order that the entry in the banker's book may be at once identified, and the amount posted to the credit of the proper party. No coin can be remitted by post, unless the letter be registered.

New Members.—Every candidate for admission into the Society must be proposed by a Member; the proposer to specify in writing the full name, usual place of residence, and post-town, of the candidate, either at a Council meeting, or by letter addressed to the Secretary. Forms of Proposal may be obtained on application to the Secretary.

*** Members may obtain on application to the Secretary copies of an Abstract of the Charter and Bye-laws, of a Statement of the General Objects, &c., of the Society, of Chemical, Botanical, and Veterinary Privileges, and of other printed papers connected with special departments of the Society's business.

Members' Veterinary Privileges.

I.—Serious or Extensive Diseases.

No. 1. Any Member of the Society who may desire professional attendance and special advice in cases of serious or extensive disease among his cattle, sheep, or pigs, and will address a letter to the Secretary, will, by return of post, receive a reply stating whether it be considered necessary that Professor Simonds, the Society's Veterinary Inspector, should visit the place where the disease prevails.

No. 2. The remuneration of the Inspector will be 2*l.* 2*s.* each day as a professional fee, and 1*l.* 1*s.* each day for personal expenses; and he will also be allowed to charge the cost of travelling to and from the locality where his services may have been required. The fees will be paid by the Society, but the travelling expenses will be a charge against the applicant. This charge may, however, be reduced or remitted altogether at the discretion of the Council, on such step being recommended to them by the Veterinary Committee.

No. 3. The Inspector, on his return from visiting the diseased stock, will report to the Committee, in writing, the results of his observations and proceedings, which Report will be laid before the Council.

No. 4. When contingencies arise to prevent a personal discharge of the duties confided to the Inspector, he may, subject to the approval of the Committee, name some competent professional person to act in his stead, who shall receive the same rates of remuneration.

II.—Ordinary or Other Cases of Disease.

Members may obtain the attendance of the Veterinary Inspector on any case of disease by paying the cost of his visit, which will be at the following rate, viz., 2*l.* 2*s.* per diem, and travelling expenses.

III.—Consultations without visit.

Personal consultation with Veterinary Inspector	5*s.*
Consultation by letter	5*s.*
Consultation necessitating the writing of three or more letters.	10*s.*
Post-mortem examination, and report thereon..	10*s.*

A return of the number of applications during each half-year being required from the Veterinary Inspector.

IV.—Admission of Diseased Animals to the Veterinary College Investigations; Lectures, and Reports.

No. 1. All Members of the Society have the privilege of sending cattle, sheep, and pigs to the Infirmary of the Royal Veterinary College, on the same terms as if they were Members of the College; viz., by paying for the keep and treatment of cattle 10*s.* 6*d.* per week each animal, and for sheep and pigs "a small proportionate charge to be fixed by the Principal according to circumstances."

No. 2. The College has also undertaken to investigate such particular classes of disease, or special subjects connected with the application of the Veterinary art to cattle, sheep, and pigs, as may be directed by the Council.

No. 3. In addition to the increased number of lectures now given by Professor Simonds—the Lecturer on Cattle Pathology—to the pupils in the Royal Veterinary College, he will also deliver such lectures before the Members of the Society, at their house in Hanover Square, as the Council shall decide.

No. 4. The Royal Veterinary College will from time to time furnish to the Council a detailed Report of the cases of cattle, sheep, and pigs treated in the Infirmary.

By Order of the Council,

H M. JENKINS, *Secretary.*

Members' Privileges of Chemical Analysis.

THE Council have fixed the following rates of Charge for Analyses to be made by the Consulting Chemist for the *bonâ fide* use of Members of the Society; who (to avoid all unnecessary correspondence) are particularly requested, when applying to him, to mention the kind of analysis they require, and to quote its number in the subjoined schedule. The charge for analysis, together with the carriage of the specimens, must be paid to him by members at the time of their application.

No. 1.—An opinion of the genuineness of Peruvian guano, bone-dust, or oil-cake (each sample)	5*s.*
,, 2.—An analysis of guano; showing the proportion of moisture, organic matter, sand, phosphate of lime, alkaline salts, and ammonia	10*s.*
,, 3.—An estimate of the value (relatively to the average of samples in the market) of sulphate and muriate of ammonia, and of the nitrates of potash and soda	10*s.*
,, 4.—An analysis of superphosphate of lime for soluble phosphates only	10*s.*
,, 5.—An analysis of superphosphate of lime, showing the proportions of moisture, organic matter, sand, soluble and insoluble phosphates, sulphate of lime, and ammonia ..	£1.
,, 6.—An analysis (sufficient for the determination of its agricultural value) of any ordinary artificial manure	£1.
,, 7.—Limestone:—the proportion of lime, 7*s.* 6*d.*; the proportion of magnesia, 10*s.*; the proportion of lime and magnesia	15*s.*
,, 8.—Limestone or marls, including carbonate, phosphate, and sulphate of lime, and magnesia with sand and clay ..	£1.
,, 9.—Partial analysis of a soil, including determinations of clay, sand, organic matter, and carbonate of lime	£1.
,, 10.—Complete analysis of a soil	£3.
,, 11.—An analysis of oil-cake, or other substance used for feeding purposes; showing the proportion of moisture, oil, mineral matter, albuminous matter, and woody fibre; as well as of starch, gum, and sugar, in the aggregate	£1.
,, 12.—Analyses of any vegetable product	£1.
,, 13.—Analyses of animal products, refuse substances used for manure, &c.	from 10*s.* to 30*s.*
,, 14.—Determination of the "hardness" of a sample of water before and after boiling	10*s.*
,, 15.—Analysis of water of land drainage, and of water used for irrigation	£2.
,, 16.—Determination of nitric acid in a sample of water	£1.

N.B.—*The above Scale of Charges is not applicable to the case of persons commercially engaged in the Manufacture or Sale of any Substance sent for Analysis.*

The Address of the Consulting Chemist of the Society is, Dr. AUGUSTUS VOELCKER, F.R.S., 11, Salisbury Square, London, E.C., to which he requests that all letters and parcels (postage and carriage paid) should be directed.

By Order of the Council,

H. M. JENKINS, *Secretary.*

INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES FOR ANALYSIS.

ARTIFICIAL MANURES.—Take a large handful of the manure from three or four bags, mix the whole on a large sheet of paper, breaking down with the hand any lumps present, and fold up in tinfoil, or in oil silk, about 3 ozs. of the well-mixed sample, aud send it to 11, SALISBURY SQUARE, FLEET STREET, E.C., by post: or place the mixed manure in a small wooden or tin box, which may be tied by string, but must not be sealed, and send it by post. If the manure be very wet and lumpy, a larger boxful, weighing from 10 to 12 ozs., should be sent either by post or railway.

Samples not exceeding 4 ozs. in weight may be sent by post, by attaching two penny postage stamps to the parcel.

Samples not exceeding 8 ozs., for three postage stamps.

Samples not exceeding 12 ozs., for four postage stamps.

The parcels should be addressed: DR. AUGUSTUS VOELCKER, 11, SALISBURY SQUARE, FLEET STREET, LONDON, E.C., and the address of the sender or the number or mark of the article be stated on parcels.

The samples may be sent in covers, or in boxes, bags of linen or other materials. No parcel sent by post must exceed 12 ozs. in weight, 1 foot 6 inches in length, 9 inches in width, and 6 inches in depth.

SOILS.—Have a wooden box made 6 inches long and wide, and from 9 to 12 inches deep, according to the depth of soil and subsoil of the field. Mark out in the field a space of about 12 inches square; dig round in a slanting direction a trench, so as to leave undisturbed a block of soil with its subsoil from 9 to 12 inches deep; trim this block or plan of the field to make it fit into the wooden box, invert the open box over it, press down firmly, then pass a spade under the box and lift it up, gently turn over the box, nail on the lid and send it by goods or parcel from to the laboratory. The soil will then be received in the exact position in which it is found in the field.

In the case of very light, sandy, and porous soils, the wooden box may be at once inverted over the soil and forced down by pressure, and then dug out.

WATERS.—Two gallons of water are required for analysis. The water, if possible, should be sent in glass-stoppered Winchester half-gallon bottles, which are readily obtained in any chemist and druggist's shop. If Winchester bottles cannot be procured, the water may be sent in perfectly clean new stoneware spirit-jars surrounded by wickerwork. For the determination of the degree of hardness before and after boiling, only one quart wine-bottle full of water is required.

LIMESTONES, MARLS, IRONSTONES, AND OTHER MINERALS.—Whole pieces, weighing from 3 to 4 ozs., should be sent enclosed in small linen bags, or wrapped in paper. Postage 2*d*., if under 4 ozs.

OILCAKES.—Take a sample from the middle of the cake. To this end break a whole cake into two. Then break off a piece from the end where the two halves were joined together, and wrap it in paper, leaving the ends open, and send parcel by post. The piece should weigh from 10 to 12 ozs. Postage, 4*d*. If sent by railway, one quarter or half a cake should be forwarded.

FEEDING MEALS.—About 3 ozs. will be sufficient for analysis. Enclose the meal in a small linen bag. Send it by post.

On forwarding samples, separate letters should be sent to the laboratory, specifying the nature of the information required, and, if possible, the object in view.

H. M. JENKINS, *Secretary*.

Members' Botanical Privileges.

The Council have provisionally fixed the following rates of Charge for the examination of Plants and Seeds for the *bonâ fide* use of Members of the Society, who are particularly requested, when applying to the Consulting Botanist, to mention the kind of examination they require, and to quote its number in the subjoined Schedule. The charge for examination must be paid to the Consulting Botanist at the time of application, and the carriage of all parcels must be prepaid.

No. 1.—	A general opinion as to the genuineness and age of a sample of clover-seed (each sample)	5*s.*
„ 2.—	A detailed examination of a sample of dirty or impure clover-seed, with a report on its admixture with seeds of dodder or other weeds (each sample)	10*s.*
„ 3.—	A test examination of turnip or other cruciferous seed, with a report on its germinating power, or its adulteration with 000 seed (each sample)	10*s.*
„ 4.—	A test examination of any other kind of seed, or corn, with a report on its germinating power (each sample) ..	10*s.*
„ 5.—	Determination of the species of any indigenous British plant (not parasitic), with a report on its habits (each species)	5*s.*
„ 6.—	Determination of the species of any epiphyte or vegetable parasite, on any farm-crop grown by the Member, with a report on its habits, and suggestions (where possible) as to its extermination or prevention (each species) ..	10*s.*
„ 7.—	Report on any other form of plant-disease not caused by insects	10*s.*
„ 8.—	Determination of the species of a collection of natural grasses indigenous to any district on one kind of soil (each collection)	10*s.*

INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES.

In sending seed or corn for examination the utmost care must be taken to secure a fair and honest sample. If anything supposed to be injurious or useless exists in the corn or seed, selected samples should also be sent.

In collecting specimens of plants, the whole plant should be taken up, and the earth shaken from the roots. If possible, the plants must be in flower or fruit. They should be packed in a light box, or in a firm paper parcel.

Specimens of diseased plants or of parasites should be forwarded as fresh as possible. Place them in a bottle, or pack them in tin-foil or oil-silk.

All specimens should be accompanied with a letter specifying the nature of the information required, and stating any local circumstances (soil, situation, &c.) which, in the opinion of the sender, would be likely to throw light on the inquiry.

N.B.—*The above Scale of Charges is not applicable in the case of Seedsmen requiring the services of the Consulting Botanist.*

Parcels or letters (Carriage or Postage prepaid) to be addressed to Mr. W. Carruthers, F.R.S., 25, Wellington Street, Islington, London.

H. M. JENKINS, *Secretary.*

GOVERNORS AND MEMBERS

OF THE

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

1873.

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ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

Patroness,

HER MAJESTY THE QUEEN.

List of Governors and Members.

Life Governors and Life Members are distinguished thus †

BEDFORDSHIRE.

Governors.

†Bedford, Duke of...Woburn Abbey
†Whitbread, William H....Southill House, Bedford

Members.

Addington, Rev. H....Henlow Grange, Biggleswade
†Barnett Charles...Stratton Park, Biggleswade
†Bassett, F., M.P....The Heath, Leighton Buzzard
Bates, Thomas, jun....Eaton Green, Luton
Belcher, Charles...The Crescent, Bedford
Biggs, John...Cublington, Leighton Buzzard
†Blundell, John H....Woodside, Luton
Burgoyne, Sir J. M., Bt., M.P....Sutton Park, Potton
Clarke, William...Brack Farm, Luton
†Crawley, J. R....Melchbonrne Grange, Bedford
†Crawley, John S....Stockwood Park, Luton
Denne, William...Three Counties Asylum, Arlesey
†De Rothschild, Baron Meyer...Mentmore, Leighton Buzzard
†Duncombe, Hon. O., M.P....Waresley, Biggleswade
Fowler, Francis...Henlow, Biggleswade
†Freeman, Frederick...Speedwell Farm, Woburn
Higgins, Colonel, W.B....Picts' Hill, Bedford
†Howard, Charles...Biddenham, Bedford
†Howard, James, M.P....Bedford
James, John Prole...Cople, Bedford
Kilpin, W. Wells...Bickerings Park, Woburn
Leigh, John Gerard...The Hoo, Luton
Lindsell, Lieut-Colonel, Fairfield House, Biggleswade
Love, Peter...Midland Row, Bedford
†Oakley, George...Lawrence End, Luton
Phillips, Zachariah...Birchmoor, Woburn
Pressland, John...Thurleigh, Bedford
Purser, Henry...Wellington, Bedford
Pnrser, William...Cople, Bedford
Robinson, James C....Stevington, Bedford
Robinson, Joseph...Wilshamstead, Bedford
Rogers, John...Chellington, Bedford
†Russell, Lord C., M.P....Drakelow Lodge, Woburn
†Sebright, Sir J. G. S., Bart...Beechwood, Dunstable
Sibley, Robert...Annables Farm, Luton
Smart, W. Lynn...Linden, Woburn
Stephenson, Christopher...Woburn
Street, Frederic...Harrowden, Bedford
Street, George...Maulden, Ampthill
Thomas, John...Bletsoe, Bedford
Thornton, Harry...Goldington Bury, Bedford
Trethewy, Henry...Silsoe
†Vallentine,R.,Burcott Lodge Farm,Leighton Buzzard
Walker, John...Goldington, Bedford
Winters, George...Stratton, Biggleswade
Wythes, F....Ravensden House, Bedford

BERKSHIRE.

Governors.

Carnarvon, Earl of...High Clere Castle, Newbury
Craven, Earl of...Ashdown Park, Shrivenham
†Eyre, Charles...Welford, Newbury
†Lindsay, Colonel, R. L., M.P....Lockinge, Wantage
Ormathwaite, Lord...Warfield Park, Bracknell
Palmer, Robert...Holme Park, Reading

Members.

Akers, Henry...Black Bourton, Faringdon
Alderman, Rev. F. C....Kintbury, Hungerford
†Aldworth, W....Frilford, Abingdon
Allen, George...The Manor Farm, Old Windsor
†Allfrey, Robert...Wakefield Park, Reading
Andrews, Charles J...Greyfriars House, Reading
Armstrong, H., M.D....Brook House, Bracknell
Attenborough, Richard...Whilby Grove, Readin
Badcock, Richard...Abingdon
Bailey, J. B....4, Coley Hill, Reading
Barker, Walter R. H....Wantage
Barrett, John B....Milton House, Steventon
†Barrington, Viscount, M.P....Beckett, Shrivenham
Baskerville, Henry...Crawshay Park, Reading
†Benyon, R., M.P....Englefield House, Reading

†Body, R. B....Hyde End, Shinfield, Reading
Boydell, Harry S....Sulham, Reading
†Bradshaw, Capt., R.N....Tubney Lodge, Abingdon
Brebner, James...Norfolk Farm, Windsor Gt. Park
Bulkeley, T. F....Clewer Lodge, Windsor
†Bullock, Ferdinand...Wantage
Bunbury, Henry M....Marlston House, Newbury
†Burniston, R....Hall Place Farm, Maidenhead
†Burr, D. Higford...Aldermaston Court, Reading
Butler, Capt. J....Kirby House, Inkpen, Hungerford
Case, James...Upton, Reading
Champion, W. Wayland....Calcot, Reading
†Cherry, Geo. Charles...Denford House, Hungerford
Clark, J. H....Low Wood, Castle Hill, Maidenhead
Clutterbuck, Rev. J. C...Long Wittenham, Abingdon
Codd, H....Beenham Lodge, Aldermaston, Reading
Crowdy, G. Frederick...Faringdon
Davies, Jenkin...Englefield, Reading
De Mornay, Alfred...Cold Harbour, Wallingford
†De Schroder, Baron...The Dell, Windsor
†De Vitre, H. D....Charlton House, Wantage
Dodd, Francis...Rush Court, Wallingford
†Dunn, W. H....Inglewood, Hungerford
Dunning, Thomas T. W....Wokingham
Dupuis, Rev. G. J....Eton College, Windsor
Dutton, John...Curbridge, Faringdon
Eyre, Henry R....Shaw House, Newbury
Forbes, John M....Dropmore, Maidenhead
†Fox, William...Adbury, Newbury
†Franklin, Thomas...Ascott, Wallingford
†Franklin, W. Taylor...Ascott, Wallingford
†Garland, T. Bland...Hillfields, Reading
Garth, T. C....Haines Hill, Reading
Gillett, Charles...Lower Haddon, Faringdon
†Goodlake, F. Mills...Wadley House, Faringdon
†Gower, John L....Bill Hill, Wokingham
Graham, William...Pewet, Abingdon
Griffith, C. Darby...Padworth House, Reading
Hannam, H. J....Burcote, Abingdon
†Harper, Latimer...Chilton Cottage, Hungerford
Hercy, John...Cruchfield House, Maidenhead
†Hibbert, John...Braywick Lodge, Maidenhead
Hilliard, Rev. J. A. S....Little Wittenham, Abingdon
Holloway, Thomas...Tittenhurst Lodge, Sunninghill
†Hood, Capt. Hon. A...Cumberland Lodge, Windsor
Hopkins, John...Tidmarsh House, Reading
†Howard, Hon. James...Hazelby, Newbury
Humfrey, Heber...Ashbury, Shrivenham
Hunter, H. L....Beech Hill, Reading
†Hussey, R. H....Taplow House, Maidenhead
Jemmett, Alexander...Binfield, Bracknell
†Jenkins, John B...Kingstowne House, Abingdon
Johnson, Joseph...High Street, Windsor
Johnston, A. R..Heatherley,Crowthorne,Wokingham
Jowett, Rev. J. F...Kingston Bagpuze, Abingdon
Kimber, James W...Tubney Warren, Abingdon
†King, John G...Beedon, Newbury
King, J. Pittman...North Stoke, Wallingford
King, W. C....Warfield Hall, Bracknell
†Kingsmill, W. H....Sydmonton Court, Newbury
Kirkaldie, Viscount...Windsor
†Lane, Lieut.-Colonel...Lilly Hill, Bracknell
†Latham, Thomas...Little Wittenham, Abingdon
Lee, Captain John....Woolley Firs, Maidenhead
Lenthall, E. Kyffin... Besselsleigh Manor, Abingdon
Masterman, T. W....Gordon Lodge, Reading
Mills, John...Pinkneys Green, Maidenhead
†Monck, J. Bligh...Coley Park, Reading
Moore, E. Wells...Coleshill, Faringdon
Morland, George B....Abingdon
Morley, E....Brize Norton, Bampton, Faringdon
†Morrison, Charles...Basildon Park, Reading
Morshead, Sir W., Bart....Forest Lodge, Binfield
†Mount, W. G....Wasing Place, Reading
Nalder, Thomas...Challow, Wantage
Powell, Richard...The Hale, Benson, Wallingford
Pritchard, W. T....Angel Down Farm, Wantage
†Pusey, S. E. B. B....Pusey House, Faringdon
Quartly-Carter J....Arborfield, Reading
Russell, Sir C., Bart....Swallowfield, Reading
Sawyer, Charles...Heywood Lodge, Maidenhead
Say, R. Hall...Oakley Court, Windsor
Sharp, William...Shottesbrook, Maidenhead
Shuter, James...Crookham, Newbury
Spearing, J. B....Hurst, Wokingham
†Stevens, Rev. T....Bradfield Rectory, Reading
†Sutton, M. Hope...Cintra Lodge, Reading
Tait, Henry...Shaw Farm, Windsor
Thoyts, M. G....Sulhamsted House, Reading
†Throckmorton, Sir W., Bt....Buckland, Faringdon
Trumper, Joseph...Lake End, Windsor
†Tucker, Henry...Bourton House, Shrivenham
†Tull, Henry...Crookham, Newbury
†Tull, Richard...Crookham, Newbury
Turner, John...Englefield, Reading
†Twinch, John...Thames Street, Windsor
Valpy, R. H....Enborne Lodge, Newbury
Waldron, W. B....Poughley, Hungerford
Wallis, George...Oid Shifford, Bampton, Faringdon
Walter, Captain E....Tangley, Wokingham
Warden, T. F....Easthampstead Park, Wokingham
Wasborough, W. D....Stockham, Wantage
Wheble, J. J....Bulmerhoe Court, Reading
Wilkins, Edmund...Mortimer, Reading
†Williams, G....Buckland, Faringdon
†Williams, James...Shippon, Abingdon
†Winterbottom, J. E....East Woodhay, Newbury
Witherington, Charles...Rushall, Reading
†Wright, G. T....Stoke Farm, Wokingham

BUCKINGHAMSHIRE.

Governors.

Blount, William...Orchill, Gerrards Cross
†Chesham, Lord...Latimer, Chesham
†Coleman, Edward J....Stoke Park, Slough
†Hunt, Zachary D....Aylesbury
Murray, Charles Robert Scott...Danesfield, Marlow

Members.

Acton, William...Fern Acres, Slough
Beards, Thomas...Stowe Park, Buckingham
†Botham, George...Wexham Court, Slough
Bramley-Moore, J....Gerrards Cross
†Buckingham, Duke of...Wootten, Aylesbury
†Cantrell, Charles Seward...Riding Court, Datchet

†Cantrell, Henry...Baylis Court, Slough
†Carson, James...Spinfield, Great Marlow
Denchfield, John...Aston Abbotts, Aylesbury
Disraeli, Right Hon. B., M.P....Hughendon Manor
†Drake, Thomas T....Shardloes, Amersham
Duncan, W. G....Bradwell House, Stony Stratford
†Duncombe, Sir P. P., Bt.. Brickhill Manor, Bletchley
Du Pré, C. G., M.P....Wilton Park, Beaconsfield
Eve, Frederick...Sherrington, Newport Pagnell
Fitzroy, George...Grafton Regis, Stoney Stratford
†Fountaine, Bernard T....Stoke House, Bletchley
Fowler, J. Kersley...Aylesbury
Fowler, Richard...Broughton Farm, Aylesbury
Gaskell, Major W. P....Fulmer House, Slough
Gilbey, Alfred...Wooburn House, Beaconsfield
†Guy, John Henry...Whitchurch, Aylesbury
†Harrison, R....Wolverton, Stony Stratford
†Harter, Rev. G. G....Cranfield, Newport Pagnell
†Hubbard, Egerton...Addington Manor, Winslow
Isham, A. C....Lower Winchendon, Aylesbury
Islip, F. W....Binford Farm, Great Marlow
Ive, John G....Langley, Slough
†Jegon, Trew...Slough
Kirbell, Edward...Latimer, Chesham
Lepper, G. A....Aylesbury
Minton, Alfred...The Lawn, Datchet
Nash, H. F....Upton Lea, Slough
Nash, John...The Rectory, Langley, Slough
Newman, James...Shipton Lee, Quainton
†Newman, John...Brands House, High Wycombe
Parrott, John, jun....Stony Stratford
Paxton, Robert...Lower Winchendon, Aylesbury
†Piggott, G. Grenville...Doddershall, Winslow
Pike, William...Castlethorp, Stoney Stratford
Pullin, Stephen...Mildridge Farm, Horton, Slough
†Roads, John...Addington, Winslow
†Robarts, A. J....Lillingstone Dayrell
†Robinson, J....Clifton Pastures, Newport Pagnell
Rose, Philip...Rayners, High Wycombe
†Rowland, Richard...Creslow, Aylesbury
†Rowland, W. Rickford...Creslow, Aylesbury
Shakeshaft, Thomas...Ravenstone, Olney
Simpson, John...Potterspury, Stoney Stratford
Thompson, E. C....Woodland, Beaconsfield
Thorpe, Henry...Buckingham
Treadwell, John...Upper Winchendon, Aylesbury
†Tyringham, W. B....Tyringham, Newport Pagnell
†Verney, Sir H., Bt., M.P., Clayden House, Winslow
†Way, Lewis Albert...Alderbourne, Gerrard's Cross
†Whiting, J. Evans....Stoke Goldington, Newport Pagnell
†Whitworth, J. R....Weston Underwood, Newport Pagnell

CAMBRIDGESHIRE.

Members.

†Aveling, James T....Eldernell, Whittlesey
†Babington, Professor C. C....Cambridge
Banyard, T., jun....Poplar Hall, Horningsea
Bidwell, C. M....Ely
Branford, John W....March
†Bromley, J. R....Gesyns, Newmarket
Brown, John...Coldham Hall, Wisbeach
Bultitaft, H....Bedwellhay Grange, Ely
Burroughes, Rev. T....Gazeley, Newmarket
Catling, Captain R. C....Needham Hall, Wisbeach
Cooke, Grimwood...Horseheath Park Farm, Linton
Derry, Charles M....Gedney, Wisbeach
†Emson, H. H....Nether Hall, Cherry Hinton
†Fison, J. P....Feversham, Cambridge
Francis, Clement...Quy Hall
Fyson, Edward...Silverley, Ashley, Newmarket
Gosling, James W..Little Bradley Place, Newmarket
Grain, Peter...Shelford, Cambridge
Greene, John M....Stradishall, Newmarket
Gunnell, Thomas...Milton, Cambridge
Hall, George S....Ely
†Hamond, W. Parker...Pampisford Hall, Cambridge
Headly, Edward...New Square, Cambridge
Holben, R. Rowley...Barton, Cambridge
†Houblon, R. Archer...Bartlow, Cambridge
Huddleston, F....Sawston Hall, Cambridge
Humphrey, A....Walpole St. Peter, Wisbeach
Hurrell, Henry...Harston, Cambridge
Hurrell, William....Newton, Cambridge
Johnson, B. B....Witbersfield, Newmarket
†Johnson, Thomas...Whittlesea
Jonas, George...Duxford, Cambridge
Jonas, John Carter...3, St. Mary Street, Cambridge
Kemp, Jesse...Eastbourne Terrace, Cambridge
†Little, H. J....Coldham Hall, Wisbeach
Little, W....Littleport, Ely
†Loomes, Edward...Whittlesea
†Manners, Lord G., M.P..Cheveley Park, Newmarket
Martin, G. H....Little Downham, Ely
†Martin, Henry W....Littleport, Isle of Ely
†Martin, Joseph...Littleport, Isle of Ely
Maynard, Robert...Whittlesford, Cambridge
Moore, William...Elm House, Wisbeach
†Pate, Martin...Ely
Purkis, W....Horseheath, Linton
†Raincock, H. D....Waltons, Ashdon, Linton
Ratliff, W....Newmarket
Robins, G. F....Isleham, Soham
†Royston, Viscount, M.P....Wimpole
Rush, Thomas...Babraham, Cambridge
Slater, S. Webb...Cheveley Hall, Newmarket
Tinsley, Henry, jun....Gedney Hall, Wisbeach
Towgood, E., jun....Sawston
Towgood, Hamer...Little Shelford
Wallis, Serjeant...Granchester, Cambridge
Webb, H....Streetly Hall, West Wickham, Linton
Webb, Samuel...Babraham, Cambridge
Webb, T. V....Great Gransden, Caxton, Cambridge
Webb, Thomas...Hildersham, Cambridge
†Woodham, W. Nash...Shepreth, Melbourne
Wright, Charles...Streatham, Ely
Yorke, Hon. Eliot T....Wimpole, Arrington

CHESHIRE.

Governors.

†Davies, David Reynolds..Agden Hall, Lymm
Legh, W. John, M.P....Lyme Park, Disley, Stockport
Westminster, Marquis of, K.G...Eaton Hall, Chester

Members.

Armstrong, J. Knight...Wharton Hall, Winsford
Atkinson, William...Ashton Heyes, Chester
†Baker, Hugh Massey...Kidnall, Malpas
†Balstone, Henry K....Hale Carr, Altrincham
†Barbour, George...Kingslee, Farndon, Chester
†Barbour, R....Bolesworth Castle, Chester
Barker, Thomas...Bramall Grange, Stockport
Barton, Richard...Caldy Manor, Birkenhead
Beck, Charles W....Upton Priory, Macclesfield
Beckett, Richard...Hartford, Northwich
Beckett, Samuel...Eccleston, Chester
Bell, H....Hempshaw Brook Brewery, Stockport
Bentley, T....Davenham, Northwich
Birchall, Edward...Willaston, Nantwich
Bowers, Henry R....Abbotts Lodge, Chester
†Bowman, J. B....Sandycroft Farm, Hawarden
Bradbury, William...Bradley Green, Congleton
Brady, Charles Alldis...Calne Green, Stockport
Brady, W. Hollinshed...Chestergate, Stockport
Broadbent, J. H....Sealand, Chester
Broughton, E. Delves...Wistaston Hall, Nantwich
Byrd, David...Spurston Hall, Tarporley
Callender, Peter...Devonshire House, Birkenhead
Campbell, C. Lee...Thurstaston Hall, Birkenhead
†Carter, George John...Tatton Dale, Knutsford
†Case, J. B....Poulton Hey, Bebbington, Birkenhead
Cawley, Thomas...Nantwich
Chadwick, Thomas...Wilmslow Grange
Cholmondely, Col. Hon. G...Abbots Moss, Northwich
†Churton, John...Foregate Street, Chester
Clayton, David S....Norbury, Stockport
Cliffe, Thomas...Crewe Gates, Crewe
†Combermere, Viscount....Combermere, Nantwich
Cooke, John...Mill Moor, Macefen, Malpas
Danson, J. T....Carnsdale, Barnston, Birkenhead
Davenport, W. Bromley, M.P..Capesthorne, Congleton
Davies, G. Reynolds...Mere Old Hall, Knutsford
†Davies, James...Bollington, Altrincham
Dickson, Arthur...Queen's Park, Chester
†Dickson, G. A....Newton Nurseries, Chester
Dobell, Joseph...Leftwich, Northwich
Egerton, Hon. W., M.P..Rostbern Manor, Knutsford
Egerton, Lord...Tatton Park, Knutsford
Egerton, Sir P. de Malpas G., Bt., M.P....Tarporley
Fair, James...Tabley Villa Farm, Knutsford
†Fair, William...Aston by Budworth, Northwich
Faulkner, William...Broxton, Chester
Fitton, Samuel...Willaston, Nantwich
France-Hayhurst, Major...Bostock Hall, Middlewich
†Frost, Robert...Lime Grove, Chester
Gardner, W. A...Hough Green, Chester
Glegg, Lieut.-Col. E. Holt...Backford Hall, Chester
Gouldburn, John...Broomhall, Nantwich
Graham, Alexander...Barnston, Birkenhead
Greenwood, William...Dunham Massey, Altrincham
Griffiths, Richard C....Broughton, Chester
Gruning, Louis....Broomborough, Chester
Hardon, Edwin...Heaton Norris, Stockport
Hardwick, R....Bowden, Altrincham
Hardy, Joseph...Baguley House Farm, Northenden
Harkes, David...Mere, Knutsford
Harrison, John...Warmingham, Sandbach
Harrison, T. Ashton...Stalybridge
Hayes, John Higson...Frodsham
Heywood, W. H....Dunham Massey, Altrincham
Hill, John...Wistaston, Nantwich
†Hobson, Thomas...Pownall Hall, Wilmslow
Hockenhull, John...Tarporley
Hoggins, T...Trafford Lodge, Chester
Holland, Robert...Mobberley, Knutsford
Holland, William...Broxton, Chester
Hornby, W. H., M.P....Shrewbridge Hall, Nantwich
Howard, C. J....Stockport
Howard, Samuel...Dunham Massey, Altrincham
Hurst, Thomas...Tabley, Knutsford
Jackson, George...Higher Peover, Knutsford
Jackson, T. F....Tattenhall Hall, Chester
Johnson, Thomas...Hermitage, Frodsham
Jones, James...The Oaklands, Spurston, Tarporley
Jones, Thomas...Kiln Green, Malpas
†Kennard, Adam S....Dawpool, Birkenhead
Kirby, Thomas...Crewe Hall Farm, Crewe
Latham, G. W....Bradwall Hall, Sandbach
Leather, Simeon...Delamere, Northwich
Lees, William...Gorsty Hall, Crewe
Legh, G. Cornwall, M.P..High Legh Hall, Knutsford
†Leigh, Colonel Egerton, Jodrell Hall, Holmes Chapel
Linaker, Peter...Norton Hill, Preston Brook
Littler, J. Brotherton...Copthorne, Audlem
Lockwood, A. Carden...Chester
Lowe, John...Wheelock Heath, Sandbach
Lowe, Thomas...The Old Pale, Eddisbury, Northwich
Lowe, Thomas...Calverley Hall, Handley, Chester
Macdona, Rev. J. Cumming, West Kirby, Birkenhead
Macgregor, John...Acton, Weaverham, Northwich
McHattie, John...Chester
Mousley, George...Hooton Hall, Chester
Myott, James...Copesthorne, Congleton
†Naylor, R. C....Hooton Hall, Chester
Newhouse, Henry...Tatton Park, Knutsford
Newhouse, Richard...Bowdon
Newton, Martin...Oldfield, Altrincham
Newton, T. H....Oldfield, Altrincham
Nunnerley, John.. Buerton Hall, Nantwich
Parker, Thomas...Aldford, Chester
Parrott, T....Green Bank, Sutton, Macclesfield
Pickering, J....Pool Hall, Sutton, Chester
Potts, Charles William...Heron Bridge, Chester
Ralphs, John...Saighton, Chester
Rayner, Henry...Liverpool Road, Chester
Rigby, Thomas...Darnhill Farm, Winsford
Roberts, John...Well House, Saltney, Chester
Roberts, Robert...The Firs, Chester
Rowland, Samuel...Higher Whitley, Northwich
†Schroder, Baron W....The Rookery, Nantwich
Scragg, Thomas...Calverley, Tarporley
Shepherd, William...Eaton, Chester
Shuker, William...Calverley, Tarporley
Siddeley, John...Spring Bank, Altrincham
Siddorn, Henry...Rushton, Tarporley
Slater, Cyrus...Dunkirk, Holmes Chapel
Smith, Thomas...Mollington Farm, Chester
†Snow, T. Owen...Lack Hall, Chester
Speakman, Thomas...Doddington Park, Nantwich
Starkey, Major...Wrenbury Hall, Nantwich

Statter, John... New Brighton, Chester
†Sykes, E. H.... Edgeley, Stockport
Tabley, Lord de... Tabley House, Knutsford
Thompson, E. J.... Timperley, Altrincham
Thompson, Henry... Organsdale, Kelsall, Chester
†Tollemache, John, M.P... Tilston Lodge, Tarporley
†Torr, John, M.P... Carlett Park, Eastham, Chester.
Townshend, Charles... Chester
Vernon, William... Tarporley
Walker, Joseph... Chorlton, Nantwich
Wallworth, Joseph... White Hall, Wilmslow
Warburton, Rowland E. E.... Arley Hall, Northwich
†Watterson, W. C.... Bowdon, Altrincham
Weaver, W. R.... 108, Eastgate Street, Chester
Wilbraham, Randle... Rode Hall, Lawton
Wilkinson, S. W.... Apsley Cottage, Stockport
†Willett, Richard... Shavington, Nantwich
Williams, J. R.... Harewood Hall, Kelsall, Chester
†Williams, John... Bank, Chester
Wilson, J. Simpson... Higher Whitley, Northwich
Wilson, William... Cholmondeley, Nantwich
Wright, James... Cop House Farm, Saltney, Chester

CORNWALL.

Governor.

Robartes, Lord... Lanhydrock House, Bodmin

Members.

Barclay, John... Falmouth
†Barton, Rev. H. N.... St. Ervan Rectory, Padstow
Bishop, James... Looe
†Bolitho, Edward... Trewiden, Penzance
Bolitho, R. F.... Ponsandam, Penzance
†Bolitho, T. S.... Pendleverne, Penzance
†Bolitho, William... Penzance
Carver, Richard R.... Wenalt, St. Clears.
Clark, William... Luney Barton, St. Ewe
Coryton, Augustus... Pentillie Castle, Saltash
Dauhuz, John Claude... Killion, Truro
†Davey, J. S.... Redruth
Davey, Richard... Bochym House, Helstone
Fortescue, Hon. G.... Boconnock, Lostwithiel
Glanville, Reginald C.... Sconnor, St. Germans
Hawken, Thomas... Mellingey, St. Issey
Hoblyn, W. P.... The Fir Hill, St. Columb Minor
Hobson, James,... Hornacott Manor, Launceston
Hockin, John... Broomhill, Bude
Hosken, Samuel... Loggan Mill, Hayle
†Lobb, George, jun.... Lawhitton, Launceston
Olver, R. Sobey... Trescowe, Bodmin
Rashleigh, J.... Menabilly, Par Station
Roberts, Joseph... Southleigh, Truro
†Roberts, Wightwick... Trethill, Sheviock
†Rodd, F.... Trebartha Hall, Launceston
†Rogers, John J.... Penrose, Helston
Roscwarne, John... Nanpuska, Hayle
Stephens, Rev. F. T.... St. Mawgan
Thynne, Rev. A. C.... Penstowe, Stratton
Tremain, James... Polsue, Grampound
†Tremayne, John... Heligan, St. Austle
Trethewy, W.... Tregoose, Probus
†Tyacke, John... Merthen, Falmouth
†Vivian, A. Pendarves, M.P., St. Anthony, Grampound
Vivian, Lord... Glynn, Bodmin
Whitley, Nicholas... Truro
†Williams, F. M., M.P.... Goonvrea, Perranarworthal
Williams, Henry... Alma, Truro
Wills, John... South Petherwyn, Launceston
†Willyames, E. B., M.P.... Nanskeval, St. Columb

CUMBERLAND.

Governors.

†Lonsdale, Earl of... Lowther Castle, Penrith
†Marshall, William... Rattendale Hall, Penrith

Members.

Allison, Robert A.... Scaleby Hall, Carlisle
†Atkinson, James... Winderwath, Penrith
Barnes, Thomas... Bunker's Hill, Carlisle
Barton, Thomas... The Crescent, Carlisle
†Bell, Robert... Mallsgate, Brampton
Birkett, Joseph... Foxton House, Penrith
Blackstock, John... Hayton Castle, Maryport
Borthwick, William... Monkwray, Whitehaven
Bowman, John... High House, Sandwith
Bowstead, James Cooper... Hackthorpe Hall, Penrith
†Bowstead, Thomas... Eden Hall, Penrith
†Bridson, Joseph R.... Belle Isle, Windermere
†Briscoe, Sir Robert, Bart.... Crofton Hall, Wigton
Brown, Matthew... Scarbank, Longtown
†Coulthard, G.... Lanercost Abbey, Brampton
Cousins, Richard... Whitehaven
Cumpston, Joseph H.... Barton Hall, Penrith
†Dacre, Rev. William... Irthington Vicarage, Carlisle
Dalton, Pattinson... Cummersdale, Carlisle
Dalzell, Anthony... Stainburn Hall, Workington
Dalzell, John... Papcastle, Cockermouth
†Dees, James... Flora Ville, Whitehaven
†Dent, Wilkinson. Flass House, Kirkby Thore, Penrith
Fawcett, James... Scaleby Castle, Carlisle
†Fisher, Captain C.... Distington House, Whitehaven
†Fletcher, Capt. Joseph... Lowther St., Whitehaven
Foster, John P.... Kilhow, Wigton
†Fox, William... Abbey, St. Bees
Fraser, Henry N.... Hayclose, Penrith
†Gandy, Captain Henry... Eden Grove, Penrith
Gibbons, Thomas... Burnfoot, Longtown
Graham, James.. Parcelstown, Longtown
Gunson, John.. Ponsonby, Calder Bridge, Whitehaven
Hartley, Gilford W.... Rose Hill, Whitehaven
Heskett, William... Plumpton Hall, Penrith
Hetherington, J. R.... Carleton, Carlisle
Hetherington, R. B.... Park Head, Silloth
Highfield, George... Blencogo House, Wigton
Hodgson, W. N., M.P.... Newby Grange, Carlisle
†Hope, Joseph... Whoof House, Carlisle
Howard, Hon. C. W. G.... Naworth Castle, Brampton
†Howard, Henry... Greystoke Castle, Penrith
Hutchinson, John... Brougham Castle, Penrith
Ingledew, W.... Sceugh Farm, Penrith
†Jackson, William... Oak Bank, Carlisle
James, Captain W. E.... Barrock Lodge, Carlisle
†Jefferson, Robert... Preston Hows, Whitehaven

Jefferson, Skelton...Preston Hows, Whitehaven
Jenkinson, Wilson...The Schoose Farm, Workington
Lawson, Sir Wilfrid, Bt., M.P..Arkleby Hall, Aspatria
†Lawson, W....Brayton Hall, Carlisle
Moffat, James...Kirklinton Park, Carlisle
†Musgrave, Sir G., Bart....Edenhall, Penrith
Musgrave, John...Wasdale Hall, Holm Rook
Nelson, Thomas...Catgill Hall, Egremont
†Nicholson, James...Blencairn Hall, Penrith
Norman, William...Hall Bank, Aspatria
Oliphant-Ferguson, G. H. H., Broadfield House, Carlisle
†Parker, T. Holme...Warwick Hall, Carlisle
†Parker, William...Carlton Hill, Penrith
Railton, Henry...Snittlegarth, Wigton
Raven, John...St. Helen's, Maryport
†Rawlinson, R....Sella Park, Whitehaven
†Richardson, John...The Oaks, Dalston, Carlisle
Robertson, J....33, Queen Street, Whitehaven
Ross, John...The Grove, Ravensglass
†Salkeld, Thomas...Holme Hill, Carlisle
Sanderson, Lieut.-Col....Eden Lacey, Penrith
†Saunders, C. R....Nunwick Hall, Penrith
Scott, Jonathan...Little Crosthwaite, Keswick
Sharp, Granville...Cardew Lodge, Carlisle
Skead, Joseph...Calder Bridge, Whitehaven
†Smith, George...The Luham, Penrith
Smith, George...Fitz Farm, Aspatria
†Spedding, John J....Greta Bank, Keswick
†Staniforth, Rev. T....Storrs Hall, Windermere
†Stanley, William...Ponsonby Hall, Whitehaven
†Stirling, John...Bridekirk, Cockermouth
Sweeten, B. T....Ashgrove, Penrith
†Taylor, John...Burnfoot House, Wigton
†Thompson, Anthony...Cross, Whitehaven
†Thompson, Robert...Inglewood Bank, Penrith
Thompson, Thomas C....Milton Hall, Brampton
Tinkler, Robert...Penrith
†Todd, John...Mireside, Wigton
Towerson, John...Whitehaven
Tweddle, John...Askerton Castle
Untbank, John...Netherscales, Penrith
Vane, Sir H. R., Bart....Hutton Hall, Penrith
Varty, Thomas...Stag Stones, Penrith
†Winn, W. Fothergill...Bower Bank, Penrith
Wyndham, Horace R....Cockermouth

DERBYSHIRE.

Governors.

†Belper, Lord...Kingston Hall, Derby
Evans, Thomas William...Allestree Hall, Derby
†Heywood, Sir T. Percival, Bt...Doveleys, Ashbourne
†Vernon, Lord...Sudbury Hall, Derby

Members.

Abell, John...Middleton Park, Sudbury, Derby
Bakewell, Charles Henry...Quorndon, Derby
Barker, J. H....Rowsley, Bakewell
†Bland, Henry Wainwright...Barlow, Chesterfield
†Broadhurst, John...Foston, Derby
Bromley, John...Derby
Cammell, C....Norton Hall
Carillon, John Wilson...Wormhill, Buxton
†Carrington, T. S. T....Eaton, Doveridge, Derby
Chambers, John...The Hurst, Tibshall, Alfreton
Chawner, Richard...Hare Hill, Doveridge, Derby
Clark, William...Alfreton, Derby
†Coke, Hon. E. K....Longford Hall, Derby
Coleman, John...Park Nook, Quorndon, Derby
Copestake, T. G....Brailsford, Derby
Cottingham, John G....Chatsworth, Chesterfield
Cox, Samuel Walker...Spondon Cottage, Derby
Cox, William...Brailsford, Derby
Cox, William Thomas...Spondon Hall, Derby
Crewe, Sir J. H., Bart....Calke Abbey, Derby
Crompton, George...Chesterfield
Crompton, John George...Derby
Denman, Lord...Middleton Hall, Bakewell
†Dixon, George M....Bradley Hall, Ashbourne
Etches, Edward...Derby
Evans, Samuel...Darley Abbey, Derby
†Feilden, Robert...Coxbench, Derby
Fox, Frederick F....Melbourne, Derby
†Gardom, T. W....The Yeld, Baslow, Chesterfield
Greaves, William...Bakewell
Hardy, Arthur...Mackley House, Sudbury
Hardy, Benjamin...Ashover, Chesterfield
Harker, James...Tibshelf, Alfreton
Harris, John...Matlock
Harrison, John, jun....Snelston Hall, Ashbourne
Haywood, George...Derby
Haywood, James...Derby
Hubbersty, Henry A....Buxton
Hubbersty, William P....Wirksworth
Hurt, Albert F....Alderwasley, Belper
Johnson, Robert...Kirkireton, Wirksworth
Jowitt, Christopher...Palterton, Chesterfield
†Lea, John...Mackley Farm, Sudbury, Derby
†Lucas, Bernard...Chesterfield
†Micklethwait, Rev. J....Shirley Vicarage, Derby
Mundy, William...Markbeaton, Derby
Murray, Gilbert...Elvaston Castle, Derby
Nesfield, R. M. N....Castle Hill, Bakewell
Newton, Charles E....Mickleover, Derby
Nodder, Rev. J....Marsh Green, Chesterfield
Nuttall, James...Chaddesden, Derby
Oakes, T. H....Riddings House, Alfreton
Parkin, John...Idridgehay, Wirksworth
Prince, John...Foston Hall Farm, Derby
Radford, William...Thulston, Derby
Robson, S., jun....Melbourne
Scarsdale, Lord...Kedleston Hall, Derby
Sitwell, Rev. H. W....Stainsby House, Derby
Sitwell, R. S....Merley, Derby
Story, J. B....Lockington Hall, Derby
Strelly, R. C....Oakerthorpe, Alfreton
†Strutt, Hon. Arthur...Duffield, Derby
†Strutt, Hon. Frederick...Kingston, Derby
Tattersall, Charles...Burbage House, Buxton
Taylor, Thomas...Hopton, Wirksworth
Thomson, John...King's Newton, Derby
†Thornhill, W. Pole...Stanton Hall, Bakewell
Woolley, Joseph...Allestree, Derby
Wright, Francis...Osmaston Manor, Derby
Wright, Frank...Hill Top Farm, Ashbourne
Wright, John...The Terrace, Chesterfield

DEVONSHIRE.

Governors.

†Fortescue, Earl...Castle Hill, South Molton
Saint Germans, Earl of...Port Eliot, Devonport

Members.

Acland, Sir T. Dyke, Bt., M.P...Sprydoncote, Exeter
Arnold, George...Dolton
†Baillie, Evan...Filleigh, Chudleigh
Bayly, John...Plymouth
Bellew, J. Froude...Stockleigh Court, Crediton
Bennett, E. Gasking...Plymouth
Benson, John...Countess Weir, Exeter
Besley, Henry...South Street, Exeter
Boger, Deeble...Wolsdon, Devonport
†Boger, Hext...Lower Durnford Street, Stonehouse
Brown, George...Roborough House, Barnstaple
†Bulteel, John...Pamflete, Ivybridge
Burnard, Charles F...Compton Villa, Plymouth
†Carew, Thomas...Collipriest House, Tiverton
†Carew, W. H. Pole...Antony House, Devonport
†Carpenter-Garnier, J....South Sydenham, Tavistock
Churchill, H....Barton House, Morchard Bishop
Cleave, Benjamin W....Newcombe House, Crediton
†Clinton, Lord...Heanton Satchville, Beaford
Collier, W. F....Woodtown, Horrabridge
†Collins, John...Wonham, Bampton
Davie, Sir H. Ferguson, Bt., M.P....Creedy, Crediton
Davy, James...Flitton Barton, North Molton
†Davy, Tanner...Barton Roseash, South Molton
†Devon, Earl of...Powderham Castle, Exeter
Diamond, James...The Beeches, Axminster
Divett, John...Bovey Tracey
Drew, James...Artiscombe, Tavistock
†Drewe, E. Simcoe...The Grange, Honiton
†Duckworth, Sir J., Bart....Wear House, Exeter
Durant, Richard...Sharpham, Totnes
Eccles, H. J....Spriddlestone, Brixton, Plymouth
Elliott, Samuel...Trafalgar House, Plymouth
Elton, Sir E. M., Bart....Widworthy Court, Honiton
Fletcher, Charles E....Luscombe, Dawlish
†Gamlen, W. H....Brampford Speke, Exeter
†Garratt, John...Bishops Court, Exeter
Gordon, Charles...Wiscombe Park, Honiton
Gould, John...Poltimore, Exeter
Greenslade, John...Bolham, Tiverton
†Gurney, John H....Marldon, Totnes
†Huyshe, Rev. John...Clysthydon, Collumpton
†Johnson, John G....Cross House, Torrington
†Karslake, Rev. W. H....Mesham, South Molton
†Kennaway, Sir John, Bart....Escot, Honiton
Kensington, E. T....Beacon Downes, Exeter
Kitson, William...Torquay
Lake, John...Edgeworthy, Morchard, Tiverton
†Lopes, Sir Massey, Bt., M.P...Maristow, Roborough
†Marker, Richard...Combe, Honiton
†Martin, Gilson...Tavistock
Merson, James...South View House, North Molton
†Miles, William...Dix's Field, Exeter
Milford, Thomas...Thorverton, Cullompton
Morley, Earl of...Saltram, Plympton
Mount Edgecumbe, Earl of. Mt Edgecumbe, Devonport
Norman, G....Dinnaton, Swimbridge, Barnstaple
Norrington, Charles. .Catto Down, Plymouth
†Northcote, Rt. Hon. Sir S. Bt., M.P..Pynes, Exeter
Pennell, H. B....Dawlish
Phillips, Thomas...Princess Square, Plymouth
Pidgeon, Hubert H....Great Torrington
Pike, John...Antony, Devonport
Porter, William...Hembury Fort, Honiton
†Portsmouth, Earl of...Eggesford House
Prideaux, Sir E. S., Bart....Netherton, Honiton
†Proby, Rev. W. H. B....Colyton House, Axminster
Quartly, John...Champson Molland, South Molton
†Radcliffe, C. Lopes...Derriford, Tamerton Foliott
Riddell, Major-General...Oaklands, Chudleigh
Ridgway, Captain A....Blackanton, Totnes
Sanders, E. A....Stoke House, Exeter
Scarborough, John L....Colyford, Axminster
†Scratton, D. R....Ogwell, Newton Abbott
Shepheard, Joseph...Torpoint, Devonport
Smith, H. Trefusis...Devonport
Smith, William...High Hoopern, Exeter
Stark, W. P. Wilkinson...2, Engadina, Torquay
†Stevens, J. C. Moore...Winscott, Torrington
†Stowey, Augustus...Kenbury House, Exeter
†Strode, Major..Newnham Park, Plympton St. Mary
Tanner, J. M,...King's Nympton Park, Chumleigh
Tanton, E....Hill Farm, Torrington
†Taylor, Richard...Langdon Court, Plymouth
Thomson, Colonel...Broomford Manor, Exbourne
Trood, Edward...Matford House, Exminster
†Troyte, C. A. W....Huntsham Court, Bampton
Turner, George...Brampford Speke, Exeter
Turner, James T....Thorverton, Cullompton
†Walrond, J. Walrond...Broadfield, Cullompton
Ward, Samuel...St. David's, Exeter
Watson, R. H....Dorsely, Harberton
†Webber, Charles H....Buckland, Barnstaple
†West, R. Thornton...Streatham Hall, Exeter
Willett, John S....Petticombe, Torrington
Wippell, Henry...Alphington, Exeter
Wroth, Edward...Bigbury Court, Ivybridge
†Wyndham, J. Evelyn...Exmouth

DORSETSHIRE.

Governors.

Ilchester, Earl of...Melbury, Dorchester
†Portman, Lord...Bryanston House, Blandford

Members.

†Baker, Sir E. Baker, Bt...Ranston House, Blandford
Benjafield, N....Motcombe, Shaftesbury
Bennett, Stephen White...Wareham
Bingham, Col. R. H..Bingham's Melcombe, Dorchester
Bridge, Thomas...Wynford Eagle, Dorchester
Buckman, Professor...Bradford Abbas, Sherborne
†Burt, H. C....Witchampton, Wimborne
†Calcraft, J. H....Kempstone, Corfe Castle
Chick, John...Compton Vallence
Chick, Thomas...Stratton, Dorchester
Crane, James...Tolpuddle, Dorchester

Digby, G. D. Wingfield...Sherborne Castle
Digby, Lord...Minterne House, Dorchester
Dowden, Thomas E....Roke Farm, Bere Regis
†Drax, J. S. W. Erle...Charlborough Park, Blandford
†Eddison, Francis...60, High West Street, Dorchester
Ethelston, Rev. C. W....Up Lyme, Lyme Regis
Evans, George...Wimborne
Evans, Captain T. B....Uddens, Wimborne
†Farrer, O. W....Binnegar Hall, Wareham
Filliter, Freeland...St. Martin's House, Wareham
Flower, Charles Henry...France Farm, Blandford
†Floyer, John, M.P....Stafford, Dorchester
Fookes, Henry...Whitechurch Farm, Blandford
Ford, John...Rushton Farm, Blandford
Frampton, Henry...Okers Wood, Dorchester
Fry, Thomas...Baglake Farm, Dorchester
Galpin, George...Tarrant Keynston, Blandford
Galpin, John...Dorchester
†Genge, Richard...Puddleton, Dorchester
†Goodden, John... Over Compton, Sherborne
Hambro, Charles, M.P....Milton Abbey, Blandford
Harding, James...Waterson, Dorchester
Homer, John G....Martinstown, Dorchester
Huxtable, Archdeacon...Sutton Waldron, Blandford
James, J. W....Mappowder, Blandford
Kindersley, E. Leigh...Clyffe, Dorchester
Lambert, W. C....Stepleton Manor, Dorchester
Legg, T. Fry...Burton Bradstock, Bridport
Legge, Benjamin...Litton Cheney, Dorchester
Luff, J. W....Canford, Wimborne
Mayo, Henry...Cokers Frome, Dorchester
†Medlycott, Sir W. C., Bt...Milborne Port, Sherborne
†Paget, Colonel...Park Homer, Wimborne Minster
Palmer, Robert...Bexington, Bridport
Pitfield, A. J....Eype, Symondsbury, Bridport
Pitfield, John...Symondsbury, Bridport
†Pope, John...Symondsbury, Bridport
†Portman, Hon. W. H. B., M.P....Bryanston, Blandford
Randall, R. G....Winfrith, Dorchester
Rodgett, Miles...Sandford, Wareham
Saunders, T. Chapman...Watercombe, Dorchester
Shaftesbury, Earl of, K.G....St. Giles's, Cranbourne
Sheridan, R. Brinsley...Frampton Court, Dorchester
Smith, J. Azariah...Bradford Peverell, Dorchester
†Spurr, Anthony...Dowlands, Lyme
Sturt, H. Gerard, M.P....Crichel, Wimborne
†Thompson, William...Weymouth
†Vavasour, Sir H. M., Bart....Beaminster
Voss, W. J....West Bucknowle, Corfe Castle
Weld, Edward J....Lulworth Castle, Wareham
†Williams, Robert...Bridehead, Dorchester

DURHAM.

Governor.

†Bowes, John...Streatham Castle, Staindrop

Members.

Allison, James John...Sunderland
Apperley, Newton W...Rainton Gate, Fence Houses
Archer, Thomas, jun....Dunston, Gateshead
†Backhouse, Edmund, M.P...Polam Hill, Darlington
Bainbridge, Robert S....Cheetham Hall, Staindrop
Blenkinsop, John...Simon Side House, South Shields
Bolam, Harry G....Keverstone, Staindrop
Boyd, E. Fenwick...Moor House, Durham
†Briggs, Captain C. J....Hylton Castle, Sunderland
Brodie, John...Braken House, Melsonby, Darlington
Brown, Ralph...Whickham, Gateshead
Bulmer, Jeffery, jun...Middleton-on-Row, Darlington
Burden, Rowland...Castle Eden, Stockton-on-Tees
†Cadle, Miles...Stockton-on-Tees
Clarke, Nathaniel...Beamish Park, Fence Houses
Cleasby, R. H....Broomside House, Durham
†Cochrane, A. H....Langton Grange, Darlington
Crawford, John...Lumley Park, Fence Houses
Darling, Robert...Plawsworth, Fence Houses
Dent, Ralph John...Streatham House, Darlington
Easton, George...Horsley Hill, South Shields
†Easton, James...Nest House, Gateshead
†Eden, John....Beamish Park, Chester-le-Street
Ettrick, Anthony...North Hylton, Sunderland
Farley, Stephen L....Chester-le-Street
Fawcett, John...Durham
Finney, Samuel...Gateshead
Forster, George E....Washington, Durham
Fowler, James...Park Hill House, Ferry Hill
Furneis, John...East Hill, Coxhoe, Ferry Hill
Gillow, Rev. Charles...Ushaw College, Durham
†Greenwell, Thomas...Broomshields, Darlington
Hawdon, W. W...Walkerfield, Staindrop, Durham
Headlam, Morley...Whorlton, Darlington
†Headlam, Right Hon. T. E., M.P....Gilmonby Hall, Barnard Castle
Henderson, John...Horsely Hall, South Shields
Heslop, Isaac...Urpeth, Chester-le-Street
Hunt, A. H....Birtley House, Chester-le-Street
Hunter, John J....Whickham Grange, Gateshead
Hutt, Right Hon. Sir W., K.C.B., M.P...Gibside Hall, Gateshead
Johnson, Edward...The Deanery, Chester-le-Street
Johnson, F. D....Aykleyheads, Durham
Kay, Richard...Forcett Valley, Darlington
Liddell, George, jun ...Great Chilton, Ferry Hill
Liddell, Hon. H. G., M.P....Ravensworth Castle
Maclaren, Henry...Offerton Hall, Sunderland
Maclaren, William...Herrington Hill, Sunderland
Michell, John...Forcett Park, Darlington
Milbank, A. Sussex...Barnard Castle
Monks, James...Aden Cottage, Durham
Moore, George...White Hall, Wigton
Morgan, George...Cleves Cross, Ferry Hill
Morgan, M....Coppy Crooks, Bishop Auckland
Morton, H. T....Biddick Hall, Fence Houses
†Ogden, John M....Sunderland
Parrington, John...Braneepeth, Durham
†Pease, J. W., M.P....Woodlands, Darlington
†Pease, Edward...Greeucroft West, Darlington
Quelch, J. Bewick...Bowburn House, Ferryhill
Ravensworth, Lord..Ravensworth Castle, Gateshead
Reay, Matthew...Heworth, Gateshead
Rowlandson, Christopher ...The College, Durham
Rowlandson, Samuel...The College, Durham
†Rowlandson, S....Newton Morrell, Darlington

Scarth, T. Freshfield. . .Keverstone, Darlington
Scarth, W. Thomas. . .Keverstone, Darlington
Scawin, Thomas. . .Durham
Shipperdson, Rev. E. H..Hermitage, Chester-le-Street
Smith, Henry. . .Eshe Hall, Durham
Steward, William. . .Lambton, Fence Houses
Stowell, W. Stow, jun.. . .Darlington
Stratton, George. . .Spinnymoor House, Durham
Thompson, James. . .Bishop Auckland
Thompson, Rev. William. . .Esbe Land, Durham
Walker, R. C.. . .Owton Manor House, Greetham, Stockton-on-Tees
Wall, G. Young, jun.. . .39, North Bailey, Durham
Wallace, Henry. . .Trench Hall, Gateshead
Wharton, Rev. W. F.. . .Barningham, Darlington
Wilkinson, P. S.. . .Mount Oswald, Durham
Wilkinson, Robert. . .Little Chilton, Ferry Hill
Williamson, Sir H., Bart., M.P.. . .Whitburn Hall, Sunderland
Williamson, Rev. R. H.. . .Hurworth, Darlington
Wilson, Charles. . .Shotley Park, Durham
†Wilson, R. Bassett. . .Cliffe House, Darlington
Wood, John. . .Harewood Hill, Darlington
Wooller, W. A.. . .Sadberge Hall, Darlington

ESSEX.

Governors.

Courtauld, Samuel. . .Gosfield Hall, Halstead
†Warner, Edward. . .Higham Hall, Woodford

Members.

†Abrey, T. Shaw Hellier. . .Witham
Allerton, Alexander R.. . .Colemans, Prittlewell
Baker, John. . .Hockley, Rayleigh
†Barclay, W. Leatham. . .Knotts Green, Leyton
Beadel, William James. . .Chelmsford
Bentall, E. H., M.P.. . .Heybridge, Maldon
†Boghurst, William P.. . .Frating Abbey, Colchester
Bott, Joseph Fennell. . .Morrell Roothing, Dunmow
†Braybrooke, Lord. . .Audley End, Saffron Walden
Bridge, Thomas. . .Buttsbury, Ingatestone
†Brise, Lieut. Col. S. B. R., M.P..Spains Hall, Braintree
†Burnell, Edward. . .Chappel, Halstead
Bury, Charles. . .Nazing
Butler, Edward. . .Ewell Hall, Kelvedon
Catchpool, Edward. . .Feering Bury, Kelvedon
†Chafy, Westwood W.. . .Bowes House, Ongar
Chaplin, J. R..Three Chimneys, Ridgewell, Halstead
Cheffins, Henry. . .Little Easton Manor, Dunmow
Christy, James. jun.. . .Boyuton Hall, Chelmsford
Clarke, John. . .The Roos, Saffron Walden
Coleman, H. S.. . .Chelmsford
†Colvin, B. B.. . .Monkhams Hall, Waltham Abbey
Corder, Edward. . .Writtle, Chelmsford
†Cure, Capel. . .Blake Hall, Ongar
Davey, Charles M.. . .Witham
Davey, H. M.. . .Beverley Villas, Colchester
Davies, Robert C.. . .Southminster, Maldon
Duffield, James. . .Great Baddow, Chelmsford
Eddington, William. . .Chelmsford
Ellis, Samuel H.. . .Maldon
Francis, Frederick. . .Ramsden Hall, Billericay
Gilbey, Walter. . .Hargreaves Park, Stanstead
†Gonne, Charles. . .Warley Lodge, Brentwood
Griggs, George. . .Oaklands, Romford
†Gurdon, William. . .Brantham, Manningtree
†Gurdon-Rebow, Hector J..Wyvenhoe Pk., Colchester
Hall, Collinson. . .Navestock, Romford
Hanbury, Osgood, jun.. . .Howe Hatch, Brentwood
Hardy, James. . .Jaques Hall, Manningtree
Havers, William. . .Bacon's Farm, Mountnessing
Heathcote, R. Boothby. . .Friday Hill, Chingford
Hobbs, William. . .Derwards Hall, Bocking
Honywood, Mrs.. . .Mark's Hall, Kelvedon
Hope, William. . .Parsloes, Barking
Hunt, Reuben. . .Earls Colne
Hutley, Jonathan. . .Rivenhall Hall, Witham
Impey, William. . .Broomfield Hall, Chelmsford
†Jonas, F. M.. . .Chrishall Grange, Saffron Walden
†Jonas, George. . .Ickleton, Saffron Walden
†Kemble, Thomas. . .Runwell Hall, Chelmsford
King, George. . .Saffron Walden
Knight, Joseph. . .Inworth Grange, Kelvedon
†Lay, John Watson. . .Walcotts, Great Tey
†Lennard, Sir T. B., Bart.. . .Belhus House, Avely
†Lowndes, G. A.. . .Barrington Hall, Harlow
McIntosh, D.. . .Havering Park, Romford
Marriage, John. . .Moulsham Lodge, Chelmsford
Mashiter, Thomas. . .Priests, Romford
Masters, A. E..Nevendon Hall, Wickford, Chelmsford
Mechi, John J.. . .Tiptree Hall, Kelvedon
Meeson, W. T.. . .Doggetts, Rochford
†Meyer, Herman, P. D.. . .Little Laver Hall, Ongar
†Meyer, P. Herman. . .Stondor Place, Brentwood
Moss, Benjamin. . .Ashington Hill, Rochford
Newcombe, Samuel. . .White Crofts, Orsett
Page, W. jun.. . .Southminster, Maldon
†Papillon, P. O.. . .Lexden, Colchester
Parsons, C.. . .North Shoebury Hall, Rochford
Paxman, James. . .Bank Buildings, Colchester
Payne, Henry. . .Birdbrook, Halstead
†Perry-Watlington J. W.. . .Moor Hall, Harlow
Pertwee, James. . .Boreham, Chelmsford
Phillips, J. R. S.. . .Riffhams Lodge, Danbury
Piggot, J. Algernon. . .Beckingham Hall, Witham
Puckridge, A. F.. . .Higham Court, Woodford Green
Quy, Edward. . .Goldhanger, Maldon
Rand, William. . .Saffron Walden
Ray, R. H.. . .Walden Hall, Saffron Walden
†Ray, Samuel. . .Great Yeldham, Halstead
Ridley, T. D.. . .Chelmsford
Rist, Isaac. . .Brantham Hall, Manningtree
†Ross, James. . .Hatfield, Broad Oak
†Rosslyn, Earl. . .Easton Lodge, Dunmow
Rust, W. H.. . .Falconers Hall, Chelmsford
Sandle, William. . .Great Bardfield, Braintree
†Scragg, William. . .Great Clacton, Colchester
Sewell, Daniel. . .Beaumont Hall, Colchester
Shirley, T.. . .Pond Cross Farm, Newport
Smijth, Sir W. B., Bart.. . .Horham Hall
†Smith, Sir C. Cunliffe W., Bart.. . .Suttons, Romford
Smyth, James. . .Peasenhall, Witham
†Snell, John F.. . .Witham House
Stable, R. Scott. . .George Lane, Woodford

Stane, J. Bramston...Forest Hall, Ongar
Sturgeon, C....South Ockendon Hall, Romford
Sworder, W....Tawney Hall, Romford
Symondson, G....Upshire Hall, Waltham Abbey
Tayler, Rowland...Colchester
Teverson, Henry...High Garrett, Braintree
†Thompson, W., jun....Thorpe-le-Soken, Colchester
†Townsend, Rev. C. G. G...Hatfield Peverell, Chelmsford
Tyler, John...Leyton
†Vaizey, John R....Attwoods, Halstead
Vickerman, Charles R....Thoby Priory, Brentwood
Wagstaff, T....Stifford, Romford
Ward, John...East Mersea, Colchester
†Warren, Rev. J. C. B....Horkesley Hall, Colchester
Webster, Charles...Waltham Abbey
Welch, Henry James...Bendysh Hall, Radwinton, Saffron Walden
†Western, Sir T. Bart...Felix Hall, Kelvedon
†Western, T. Sutton...Felix Hall, Kelvedon
†Westhorpe, Rev. R. A....Berners Roding, Ongar
†White, A. Holt...Clement's Hall, Rochford
Whitlock, F...Lovingtons, Great Yeldham, Halstead
Whitlock, John...Great Yeldham Hall, Halstead
Wingfield, R. Baker...Orsett Hall, Romford
Wood, George...Rochford
Woodward, F. Spencer...Great Saling, Braintree
Woodward, Henry...Stanway Hall, Colchester

GLOUCESTERSHIRE.

Governors.

†Barker, John Raymond...Fairford Park, Fairford
†Goldsmid, Sir F. H., Bt...Rendcomb Pk., Cirencester
Hale, Robert Blagden...Alderley Park, Wotton
Hartley, W. H. H...Lye Grove, Cross Hands, Sodbury
†Holford, R. S., M.P....Weston Birt House, Tetbury
†Northwick, Lord...Moreton-in-the-Marsh
Sotheron-Estcourt Rt. Hn. T. H. S...Estcourt, Tetbury

Members.

†Ackers, B. St. John...Prinknash Park, Painswick
Acock, Arthur...Cold Aston, Northleach
Anderson, Robert A....Cirencester
Arkell, Daniel...Dean Farm, Hatherop, Fairford
Arkell, H....Butlers Court, Boddington, Cheltenham
Arkell, Thomas...Boddington, Cheltenham
Arkell, William, Hatherop, Fairford.
Avery, Thomas Charles....Gloucester
Badham, George...Wingmoor, Cheltenham
†Bailey, Henry...Cirencester
Baker, H. Orde Lloyd...Hardwicke Court, Gloucester
†Baker, T. Barwick L...Hardwicke Court, Gloucester
†Barton, Charles...Fifield, Lechlade
Bathurst, Earl...Ockley Park, Cirencester
Bazley, Thomas S....Hatherop, Fairford
Beach, J. Allen...The Park, Redmarley, Newent
†Beach, Sir M. E. H., Bt., M.P.. Williamstrip Pk., Fairford
Beaven, C...Ivy House Frm., Shipton Moyne, Tetbury
Bell, Captain Henry...Chalfont Lodge, Cheltenham
Bengough, J. C....The Ridge, Wotton-under-Edge
Bennett, John...Belle Vue House, Cheltenham
Bennett, William...Goldwick Farm, Berkeley
†Blackwell, G., jun....Kingscote, Wotton-under-Edge
Bowly, Edward...Siddington House, Cirencester
Bowly, William...Cirencester
Bravender, John...Cirencester
Browne, T. Beale...Salperton Park, Andoversford
†Bubb, Anthony...Whitcombe Court, Gloucester
†Burnett, Francis...Kingscote, Wotton-under-Edge
Cadle, Clement...Clarence Street, Gloucester
†Cadle, Thomas...Longcroft, Westbury-on-Severn
Campbell, R....Buscot Park, Lechlade
Capel, William...The Grove, Stroud
Castree, Josiah...College Green, Gloucester
Castree, Josiah, jun....College Green, Gloucester
†Cole, Henry...Ashbrook, Cirencester
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Cooke, James Herbert...Berkeley Castle
Creese, William...Teddington, Tewkesbury
Croome, J. Capel...Bagendon House, Cirencester
†Cummins, John, jun....Nelfields, Newent
Daubeny, Rev. E. A....Ampney, Cirencester
†Davies, Robert P....Horton, Chipping Sodbury
†Dent, John Coucher...Sudeley Castle, Winchcombe
De Winton, Capt. T....Wallsworth Hall, Gloucester
Dobbs, Samuel Priday...Huntley, Gloucester
†Dowdeswell, A. C....Pall Court, Tewkesbury
Dowdeswell, Benjamin...Castle Eaton, Fairford
†Dowdeswell, W. E., M.P...Pall Court, Tewkesbury
Drew, B...,Boxwell, Wotton-under-Edge
Drew, Edwd...Calcot, Kingscote, Wotton-under-Edge
†Ducie, Earl of...Tortworth, Wotton-under-Edge
Edmonds, Giles...Eastleach, Lechlade
Edmonds, William John...Southrope, Lechlade
Ellett, Robert...Oakley Villa, Cirencester
Elwes, John H....Closeburn House, Cheltenham
Farmer, Edmund...Moreton-in-the-Marsh
Ferris, John Wakefield...Far Hill Farm, Fairford
†Fitzhardinge, Lord...Berkeley Castle
Fletcher, George...Shipton, Cheltenham
†Fletcher, W. H....Shipton Olliffe, Cheltenham
Fowler, William...Ryle House, Pauntley, Newent
Fulljames, Thomas...Foscombe, Gloucester
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Garne, Thomas...Broadmoor, Northleach
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Hitchman, John, M.D....Cedar Lodge, Cheltenham
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Jones, John...Tuffley, Gloucester
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Knight, John...Forthampton, Tewkesbury
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Long, Daniel...Whaddon, Gloucester
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Mabbett, John...Stinchcombe, Dursley
Mace, Thomas...Sherborne, Northleach
Makgill, George,..Prestbury, Cheltenham
Marsh, W. J....Loridge, Berkeley
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Mellersh, T. G....2, Southfield Villas, Cheltenham
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New, Richard E....Hartpury, Gloucester
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Parson, Edgecombe...Coates, Cirencester
Peacey, William...Chedglow, Tetbury
Penson, W. Stayt...Baunton, Cirencester
Phillimore, Edward...Cheltenham
Porter, Thomas...Baunton, Cirencester
Porter, William...Kencott, Lechlade
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Villar, James...Charlton Kings, Cheltenham
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White, Edwin...Maisemore, Gloucester
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Best, Rev. Thomas...Red Rice House, Andover
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Boxall, W. B....Strathfieldsaye, Winchfield
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Chalcraft, James...Stroud, Petersfield
Chalcraft, William...Bramshot House, Liphook
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Cumberbatch, L....Queens House, Lyndhurst
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Lane, John..Gatcombe House,Newport, Isle of Wight
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Leggatt, S. B....Crofton, Titchfield
Linzee, Robert G....Jermyns, Romsey
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Mills, John...Bisterne, Ringwood
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Nichols, Ben...West End Farm, Aldershot
†Nightingale, W. E....Embley, Romsey
†Ohrly, H. G., jun..Downside, Ventnor, Isle of Wight
Padwick, Richard...West Thorney, Emsworth
Pain, Thomas...The Grove, Basingstoke
Palmer, George...Greenwood, Bishops Waltham
Parkin, P. W....Ridgemount, Bassett, Southampton
†Peacocke, Warren...Efford, Lymington
Perkins, Walter, Bowling Green House, Southampton
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†Pinnegar, Christopher...Rockbourne, Fordingbridge
Pratt, Frederick...Westmeon, Petersfield
Pulteney, J. G. Beanmont...Lyndhurst
Purrott, C....Cliftonville, Westend, Southampton
†Raynbird, Hugh...Church Street, Basingstoke
†Ricards, Mortimer...Bure Homage, Christchurch
Ridge, T. J....Hambledon, Horudean
Rosling, Edward...Droxford, Sonthampton
Salt, Herbert...Thorns, Lymington
Scott, T. R....Porchester Farm, Fareham
Seal, C. W....Herriard Grange, Basingstoke
Shrubb, J. Lane...Rodlease, Lymington
Simonds, W. B., M.P....Abbot's Barton, Winchester
†Spooner, W. C....Southampton
†Stratton, James...Chilcombe, Winchester
Tasker, William...Andover
Taylor, Sir Charles, Bart....Forest Lodge, Liphook
†Taylor, H. Minton...Shaldon Manor, Alton
Thistlethwayte, T....Southwicke Park, Fareham
Timson, Rev. E....Tatchbury, Southampton
Torr, Rev. T. J....Dummer House, Basingstoke
Toward, Andrew...Osborne, Isle of Wight
Trimmer, Charles...Alton
†Waddington, John...Langrish House, Petersfield
†Walker, James...Buriton Manor Farm, Petersfield
Wallis, Arthur...Basingstoke
Warner, Henry, jun....Farringdon, Alton
Wellington, Duke of...Strathfieldsaye, Winchfield
†Whitear, R. B....Martyr Worthy, Winchester
Whitley, Henry E....Basingstoke
†Winchester, Marquis of...Amport House, Andover
Wood, Henry...Woolley House, Romsey
†Wood, John...Sheddon Grange, Alton
Woodman, Richard...Somborne Park, Stockbridge
Wooldridge, Henry...Meon Stoke, Bishops Waltham

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†Clive, Rev. Archer...Whitfield Court, Hereford

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†Barnaby, William...Clater Park, Bromyard
†Bateman, Lord...Shobden Court, Shobden
Beever, Rev. W. Holt...Pencraig Court, Ross
Bennett, James...Ingestone, Ross
Birch, T....Broomyhill Farm, Belmont, Hereford
Blashill, Henry...36, New Market Street, Hereford
†Blissett, Rev. H....Letton Weobley, Hereford
Bosley, John...Lower Leyde, Hereford
Boulton, Richard C....Lower Ballingham, Ross
Bradstock, Thomas S....Cobrey Park, Ross
Bray, George...The Haven, Pembridge
Britten, William E....Stapleton, Presteign
Brown, Thomas James...The Moor, Hereford
Brunsdon, Benjamin...Ross
Cadle, John...Ross
Caldwall, Bonham...Leominster
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Clark, Thomas...Derndale, Hereford
Clive, George...Perrystone, Ross
†Cooke, Henry...Widemarshe Street, Hereford
†Cotterell, Sir H. G., Bart....Garnons, Hereford
†Cranston, Thomas...Little Dilwyn, Leominster
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Davies, Thomas...Burlton Court, Burghill, Hereford
Dew, Tomkyns...Whitney Court, R.S.O.
Downing, J. Bearcroft...Holme Lacey, Hereford
Duckham, Thomas...Baysham Court, Ross
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Edwards, Henry N....Broadwood, Leominster
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Evans, H. R., jun....Swanstone Court, Leominster
†Evans, R. W....Eyton Hall, Leominster
†Evans, Rev. William E....Burton Court
Farmer, James...Lawton, Pembridge
†Farr, Richard...Hereford
Garrold, R. H....Kilforge, Ross
Gibbons, Henry...Hampton Bishop, Hereford
Godwin, William...Lugwardine, Hereford
Greenly, Charles Williams...Titley Court, Titley
Griffithes, Edward...New Court, Hereford
Griffiths, John Harward...The Weir, Hereford
Hall, George...Garford, Yarkhill, Ledbury
†Hall, William...Ashton, Leominster
Harrison, Colonel Broadley...Kynastone, Ross
†Hawkins, Thos., jun...Mannington House, Hereford
Haywood, Henry...Blakemere House, Hereford
†Herbert, John Maurice...Rocklands, Ross
Heygate, Captain E. N....Buckland, Leominster
†Higginson, E....Saltmarsh, Bromyard
Hill, Rev. R. P....Bromesberrow, Ledbury
Hopton, John...Canon Frome Court, Ledbury
Hoskyns, C. Wren, M.P....Harewood, Ross
Jackson, P. R....Blackbrook, Gresmont, Hereford
†Jowitt, Thomas...The Old Weir, Hereford
Morris, John...Town House, Madley, Hereford
Morris, Walter...Dewsall Court, Hereford
Mumford, William...Credenhill, Hereford
Partridge, John...Bishops Wood, Ross
†Pateshall, Evan...Allensmore Court, Hereford
†Pitt, George...Chadnor Court, Dilwyn, Leominster
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†Power, K. Manley...The Hill Court, Ross
†Prosser, F. Wegg...Belmont, Hereford
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†Pye, G....Widemarshe Street, Hereford
†Ridler, R. H....Holme Lacey, Hereford
†Riley, John...Putley Court, Ledbury
†Robinson, S....Lynhales, Kington
Rogers, Thomas...Coxall, Brampton Brian
†St. John, Hon. B. M....Oaklands, Leominster
†Salvin, M. C....Sarnsfield Court, Kington
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†Stedman, James...Lucton, Leominster
†Stevenson, Capt. C. B....Hennor House, Leominster
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Taylor, William...Thingehill Court, Hereford
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Turner, Thomas...Merryvale, Ross
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Winnall, John...Eccleswall Court, Ross
Yeld, George...Twyford, Pembridge
†Yeomans, John H....Stretton Court, Hereford

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Baxendale, Richard B....Whetstone
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†Bennell, Joseph...Hitchin
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Booth, E. W....Trent Park Farm, New Barnet
†Bosanquet, H. S....Broxbourne Park, Hoddesdon
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Brown, William...Tring
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†Carnegie, David...Eastbury, Watford
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Clarendon, Earl of...The Grove, Watford
†Clayden, John Carter...Hadley, Barnet
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Fordham, John George...Royston
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†Hodgson, William...Gilston Park
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†Jonas, William...Heydon, Royston
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King, Charles...North Lodge Farm, Potter's Bar
Kingsby, Thomas...Boars Croft, Tring
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Lloyd, John,...Kingsbury, St. Albans
†Loyd, W. Jones...Langleybury, Watford
†Marjoribanks, D. C....Bushey Hall Farm, Watford
†Marsh, Richard...Little Offley House, Hitchin
Mello, William...Chadwell, Ware
Mott, Thomas...Much Hadham, Ware
Nash, Charles...Royston
Nnnn, Edmund B....Royston
Parker, William...The Park, Ware
†Parris, J. W....Farnham, Bishop Stortford
Parry, Nicholas...Little Hadham, Ware
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Peart, Isaac...Tewin Bury, Hertford
†Perkins, Henry...Thriplow, Royston
†Perkins, Thomas...Hitchin
Pocock, George...Holywell House, St. Albans
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Prout, W. A....Blounts, Sawbridgeworth
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Roberts, Edward...Berden Hall, Bishop Stortford
Roberts, W. H....Alms Hoe Bury, Hitchin
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Sedgwick, A. O....Watford
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†Smith, Robert...Goldings, Hertford
Snewing, Charles...Holywell Farm, Watford
†Strafford, Earl of...Wrotham Park, Barnet
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†Thurnall, Henry...Royston
Tompkins, John...Town Farm, Ivinghoe, Tring
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Wilkins, R. U....Broadfield, Buntingford
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†Wimbush, Barnes...New Barnet
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Wortham, Biscoe Hill...Royston

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†Greene, Harry Arthur...Crown Street, St. Ives
†Heathcote, John M....Connington Castle, Stilton
How, James...Broughton, Huntingdon
†Johnstone, Rev. George...Broughton
†Linton, Rev. J....Hemingford House, St. Ives
†Manchester, Duke of...Kimbolton Castle
†Margetts, Charles...Huntingdon
Middleton, Saville...Water Newton
†Morrison, John...Bushmead Priory, St. Neots
†Newton, G. Onslow...Croxted Park, St. Neots
†Newton, S. C....The Down, Croxton, St. Neots
†Peppercorne, J. H....Eaton Socon, St. Neots
Purves, Peter...Brampton, Huntingdon
Rowell, John...Ramsey
Rust, James...Alconbury, Huntingdon
Sandwich, Earl of...Hinchingbrooke House
†Sherard, Lord P. Castel...Glatton, Stilton
Squire, Edward F....Cross Hall, St. Neots
†Stuart, Lieut.-Colonel...Tempsford Hall, St. Neots
Thornhill, George...Diddington, Huntingdon
†Tillard, Philip...Stukely Hall, Huntingdon
Welstead, F....The Cottage, Stoneły, Kimbolton
Willson, J. Larkham...Kimbolton
Windover, Charles S....Huntingdon

KENT.

Governors.

Darnley, Earl of...Cobham Hall, Gravesend
Fitz Walter, Lord...Godnestone Park, Wingham

Loyd, Lewis... Monks Orchard, Bromley
†Torrington, Viscount... Yokes Court, Mereworth

Members.

†Abergavenny, Earl of... Eridge Castle, Tunb. Wells
†Adams, G. T.... Hawkhurst
Alexander, J. C.... Herne Hill, Faversham
†Alexander, R., C.B.... Downs House, Staplehurst
Amos, James, jun.... Broomfield, Herne Bay
†Anderson, William... Lesney House, Erith
Andrews, Onslow... Brabourne, Ashford
†Appach, Reginald... Maytham Hall, Rolvenden
Arabin, W. St. Julien... Pope Street, Eltham
Arbuthnot, W. Urquhart... Bridgen Place
Aveling, Thomas... Rochester
Aweock, Henry... Oxen Heath, Tunbridge
Bacon, James... Pluckley, Ashford
Baker, Fredk.... Manor Farm, Frindsbury, Rochester
Baldwin, W. T.... Steed Hill, Maidstone
†Balston, Richard J.... Boxley Abbey, Maidstone
Balston, Thomas... Cbart Sutton, Staplehurst
†Bannerman, Henry... Hunton Court, Maidstone
†Bayden, Thomas... Hythe
†Bayden, Thomas, jun.... Hythe
†Beale, William... Larkins Farm, Chiddingstone
†Bean, Alfred W.... Dansome Park, Welling
†Beard, Frederic... Horton, Canterbury
Beer, James Henry... 29, St. George's St., Canterbury
Bell, Matthew... Bourne Park, Canterbury
Blenkiron, William... Middle Park, Eltham
†Blow, W. W.... Temple Mount, Belvedere Park
†Board, John... Westerham, Sevenoaks
Buckland, John A.... Biddenden, Staplehurst
Burrows, C. Acton... Lamberhurst, Hawkhurst
Bushell, William... Poulton, Wingham
Butcher, Thomas... Selling, Faversham
Butcher, William... Gosmere, Selling, Faversham
Campbell-Bannerman H., M.P.... Gennings Park, Maidstone
Carr, William... Dene Park, Tunbridge
Carter, William... Boughton Blean, Faversham
Castle, William... Yorke Farm, Strood, Rochester
Champion, F. C.... 2, Kidbrook Villas, Blackheath
†Cheesman, Frederick... Little Chart, Ashford
Chittenden, Andrew... Detling, Maidstone
Chittenden, James... Hope All Saints, New Romney
Chittenden, John... Newchurch, New Romney
Clarke, Edward S.... Glebeland House, Lee
Coatsworth, J.... Layhams, West Wickham, Bromley
Cobb, John... Sheldwick, Faversham
Cobb, Robert L.... Higham, Rochester
Cobbet, John M.... Skeynes, Edenbridge
Coleman, Richard... Langdon Abbey, Dover
Collard, Charles... Little Barton, Canterbury
†Colyer, William... North End, Crayford
†Court, P. Simpson... 140, Snargate Street, Dover
†Cox, Henry... Trevereux, Edenbridge
†Croft, Sir John, Bart.... Kingsdown, Sittingbourne
Curling, Arthur D.... Herne Hill, Faversham
Curling, Edwin Henry... Brookland, Whitstable
Dashwood, Maitland.... Hall Place, Bexley
†Dawson, William Edward... Plumstead Common
Day, John... Chilham, Canterbury
†Deacon, John... Mabledon, Tunbridge
Deedes, Lieut.-Colonel W.... Sandling Park, Hythe
†De L'Isle and Dudley, Lord... Penshurst Park
Delves, William... Hargate Lodge, Tunbridge Wells
Devas, Charles F.... Bromley Lodge
Dixon, Henry... Frankham, Tunbridge Wells
†Dowse, W. T.... Chelsfield Hall Farm, Orpington
Dyke, Sir P. H., Bart.... Lullingstone Castle, Dartford
Dyke, Wm. Hart, M.P... Lullingstone Castle, Dartford
†Easton, James... Hoath Court, Blean, Canterbury
Edwards, James L.... Rochester
Eley, W. H.... Islingham, Frindsbury, Rochester
†Elgar, Frederick... St. Margaret's, Rochester
†Ellis, Robert Ridge... Yalding
Evans, R. Percival... Watling Court, Canterbury
Evershed, John... Hartfield, Tunbridge Wells
Falmouth, Viscount... Mereworth Castle, Maidstone
Field, George... Ashurst Park
Filmer, Sir E., Bart... East Sutton Park, Staplehurst
Finnis, Sterriker... The Elms, Hougham, Dover
†Fletcher, Major-General E. C.... Kenward, Yalding
†Ford, Sir F. C., Bart.... Hartfield, Tunbridge Wells
Franks, George... Thong, Gravesend
†Fremlin, W. Arthur... Teston, Maidstone
†Fry, James Thomas... Boston, Bromley
Gardner, William... Bekesbourne, Canterbury
Gascoyne, W. Whitchead... Sittingbourne
†Geary, Sir W. R. P., Bart.... Oxen Heath, Tunbridge
Gibbens, Edward... Minster, Isle of Thanet
Godwin, J. S. S.... West Peckham, Maidstone.
†Goldsmid, Julian, M.P.... Summerhill, Tunbridge
†Goodhart, Charles E.... Langley, Beckenham
†Gordon, Admiral... Ingledon, St.-Michael's, Ashford
†Gow, James... Fowlers Park, Hawkhurst
†Hamilton, W. M.... 2, Orchard Place, Canterbury
Hankey, G. A.... Frant, Tunbridge Wells
Hardinge, E. S.... Bounds Park, Tunbridge Wells
Harvey, J. J... Statenborough House, Sandwich
Harvey, W. F.... Thruxted, Chartham, Canterbury
Hatfield, C. T.... Hartsdown House, Margate
Henderson, John... The Shrubbery, Sandwich
Herring, Frank... Brasted Park Farm, Sevenoaks
†Hilder, W.... Coldharbour Farm, Tenterden
Hilton, Henry... Selling, Faversham
Hilton, Robert S.... Harbledown, Canterbury
Hilton, S. M.... Bramhling, Wingham
Hilton, Captain T.... Nackington House, Canterbury
Hodsoll, J. Hackett... Loose Court, Maidstone
Holmden, James... Marlpit Hill, Edenbridge
Hooper, George... Cottington Court, Deal
†Hughes, Hugh... Brightling, Hawkhurst
Jackson, Thomas... Eltham Park
James, Sir W. C., Bart.... Betteshanger, Sandwich
Kibble, Thomas... Green Trees, Tunbridge
†Kingsnorth, Alfred... Great Chart, Ashford
†Kingsnorth, Edward... Brookland, New Romney
Kirkpatrick, Captain J.... Monks Horton, Hythe
Knight, Richard... Bobbing Court, Sittingbourne
Knight, Richard Lake... Bobbing, Sittingbourne
†Lake, Edward... Hill Side, Strood
Lake, Frederick... Rodmersham, Sittingbourne
Lake, J... Newlands, Teynham, Sittingbourne
Lake, Robert... Milton, Canterbury

†Lake, Robert...Oakley, Rochester
†Lake, Thomas...Tonge, Sittingbourne
Larking, J. Wingfield...The Firs, Lee
†Leese, C. Stuart...Divan Court, Faversham
Lempriere, Major H....Pembury, Tunbridge Wells
Leney, Charles...Haddon Place, Tunbridge
Leney, Edward...Hadlow Place, Hadlow
Lennard, Colonel J. F....Wickham Court, Bromley
Levett, William...Glassenbury, Cranbrook
Lewis, I. H..Gallants Court, East Farleigh, Maidstone
Love, S....The Water House, Shoreham, Sevenoaks
†Loyd, Lieut.-Col. E....Lillsden, Hawkhurst
Luck, Captain F....Hartlip, Sittingbourne
Mace, J. Ellis...Ashford Road, Tenterden
Mac George, John...Great Chart, Ashford
†Maitland, Colonel...Hollywych, Edenbridge
Mannington, A....Staplecross, Hawkhurst
Mannington, Isaac...Ewhurst, Hawkhurst
Manwaring, T...Mare Place, Brenchley, Staplehurst
Marten, John...Chilham, Canterbury
Marten, Peter...Chilham, Canterbury
†Martin, P. Wykeham, M.P...Leeds Castle, Maidstone
Mercer, W....Grove House, Hunton, Staplehurst
†Mills, J. R....Kingswood Lodge, Tunbridge Wells
Miskin, William...Hoo, Rochester
Mockford, W. G. S....Vanbrugh House, Blackheath
Monckton, Edward...The Hectorage, Tunbridge
Monckton, Frederick...Hadlow, Tunbridge
†Moore, Rev. Edward...Theobalds, Hawkhurst
Moore, Rev. G. Bridges....Tunstall, Sittingbourne
Morland, W. Courtenay..The Court Lodge, Lamberhurst
†Morley, H. Hope...Hall Place, Tunbridge
Morton, J. T....Darenth, Dartford
†Munn, Major...Churchill House, Dover
Murton, Frederick...Smeeth, Ashford
Murton, William...Tunstall, Sittingbourne
Neame, Charles...Copton, Faversham
†Neame, Edward...Selling Court, Faversham
†Neame, Edwin...Harefield, Selling, Faversham
Neame, Frederick...Macknade, Faversham
†Neame, H. B., North Court. Lower Hardres, Canterbury
Neame, Percy B....The Mount, Ospringe, Faversham
Neame, Robert...Boughton Blean, Faversham
Neve, Charles..Amberfield, Chart Sutton, Staplehurst
Neve, George...Sissinghurst, Staplehurst
Neve, Richard...Benenden, Staplehurst
†Noakes, John T....Breckley House, Lewishom
†Norman, G. Warde...Bromley
Orlebar, H. A...34, Lansdowne Rd., Tunbridge Wells
†Paine, Jeremiah...Sutton Valence, Staplehurst
†Page, Henry...Walmer Court, Walmer
†Paterson, Richard...Leesons, Chiselhurst
Peppercorne, Henry...East Malling, Maidstone
Perkins, Thomas...Willesborough, Ashford
Perkins, William...Brabourne, Ashford
Phelps, H. G. Hart...Ridley Parsonage, Wrotham
Phipps, Filmer...River, Dover
Pilcher, Jesse...Cheriton Court, Hythe
†Piper, Edward...Hensill, Hawkhurst
Playfair, G. Gedge....Errol Villa, Lee, S.E.
Plumptre, Charles J....Pedding House, Sandwich
Plumptre, J. Bridges..Goodnestone Farm, Wingham
†Pomfret, Virgil...Tenterden
Prentice, Edward...Chalk, Gravesend
Pryke, J. P....Aldersfield Hall, Wickhambrook
†Pye, Henry...St. Mary's Hall, Rochester
Pye, James...Knight Place, Rochester
Rammell, W. Lake...Sturry Court, Canterbury
Ramsbotham, J. Crowborough Warren, Tunbridge Wells
Reeves, William...Chittenden, Staplehurst
Rice, E. Royd...Dane Court, Wingham
Robinson John...Wingham, Sandwich
Romney, Earl of...The Mote, Maidstone
Russell, George...Manor House, Plumstead
Russell, John...Sutton-at-Hove, Dartford
Russell, Robert...Horton Kirby, Dartford
Rutherford, T. B....Hothfield, Ashford
Ruxton, G. F. Symonds..The Crook Farm, Brenchley Staplehurst
Salomons, Sir D., Bt., M.P...Broom Hill, Tunbridge
†Sandford, Marks...Martin, Dover
†Sankey, R. J....South Hill, Ashford
Scott, John...Wouldham, Rochester
Selmes, J....Tufton Place, Northiam, Staplehurst
Shafto, T. D....Cheveney House, Hunton, Maidstone
Sharpe, W. Barling...Baker's Cross, Cranbrook
Shrubsole, S....Hill House, Chalkwell, Sittingbourne
†Slade, A. F....Kemmal House, Chiselhurst
Smith, W....Chimhams, Farningham, Dartford
Smithell, R. Hudson...Hengrove House, Margate
Solly, G. B....Monkton Court, Ramsgate
†Stilwell, A. F....Sheperdswell, Dover
Stirling, Sir W., Bt....Burr's Wood, Tunbridge Wells
Stone, J. J....Wickham Rd., Upper Lewisham Rd.
†Stoneham, Frederick...Crayford
Stratton, Rev. J. Y....Ditton Rectory, Maidstone
†Stunt, W. C....Brogdale, Ospringe, Faversham
Sturgess, Thomas...Penshurst, Tunbridge
Swindley, Major...Herr Lackenden Ho., Woodchurch
Sydney, Viscount...Frognal, Foot's Cray
Talbot, J. Gilbert, M.P....Falconhurst, Edenbridge
Taylor, W....Wickham Court Farm, Beckenham
Toomer, George E...Preston Court, Wingham
Townend, Thomas...Knockholt
Turner, Frederick...Nizels, Tunbridge
Tylden-Pattenson, Captain...Iborndon, Biddenden, Staplehurst
Tyser, G. D....Hollanden Park, Tunbridge
†Umfreville, S. C....Ingress Abbey, Greenhithe
†Waldo, E. W. Meade...Stone Wall, Edenbridge
†Wall, William H....Pembury, Tunbridge Wells
Walter, John...Borden, Sittingbourne
Walter, William...Rainham, Sittingbourne
Warde, Ambrose...West Farleigh, Maidstone
Waring, William...Chelsfield
White, George...Hunton, Maidstone
White, J. Baker...Street End House, Canterbury
†Whitehead, Charles...Barming House, Maidstone
Whitehead, John...West Barming, Maidstone
Whitehead, Richard...West Farleigh, Maidstone
Whitworth, G....Jamaica Level, Rotherhithe, S.E.
†Wilson, Edward...Hayes, Bromley
Wood, John...Singlewell, Gravesend
Woodhams, Frank...Frindsbury, Rochester
Wyles, Thomas...Frindsbury, Rochester
Yardley, Sir William...Hadlow Park, Tunbridge

LANCASHIRE.

Governors.

†Brooks, W. Cunliffe, M.P...Barlow Hall, Manchester
Devonshire, The Duke of, K.G....Holker Hall
†Ellesmere, Earl of...Worsley Hall, Manchester
†Hoghton, Sir Henry de, Bart....Preston
Patten, Col. J. Wilson, M.P....Bank Hall, Warrington
†Sefton, Earl of....Croxteth, Liverpool
†Skelmersdale, Lord...Lathom House, Ormskirk
Towneley, Colonel Charles...Towneley, Burnley

Members.

Agnew, C. Swain...Springfield, Eccles, Manchester
Agnew, T. jun....Hopeleigh, Eccles, Manchester
Allender, H. J....Breckside Pk., Anfield, Liverpool
Ashworth, Alfred...Egerton Hall, Bolton
Ashworth, Charles E....Fairfield, Manchester
†Baldwin, W. J. A....Dalton-in-Furness
†Bannerman, Alexander...Lytham
†Barton, J....West Leigh Lodge, Leigh, Manchester
Bass, W....Duckenfield Lodge, Ashton-under-Lyne
Bate, John...10, St. Mary's, Manchester
Baxter, Henry John...Cheadle, Manchester
Baxter, Thomas...Acton Grange, Warrington
Becker, J. L....Foxdenton, Chadderton, Manchester
Beswicke-Royds, C. R. N..Pyke House, Littleborough
†Birchall, Thomas...Kibbleton Hall, Preston
Birket, C....Plungington Hall, Preston
Blackburne, J. Ireland...Hale, Warrington
Blackburne, Lt. Col. Ireland...Hale Hall, Warrington
†Boddington, Henry...Monton House, Eccles
†Bouck, John T....Manchester
Bowling, Roger...Forton Lodge, Garstang
Bradshaw, William...Levenshulme, Manchester
Brierley, Charles W....Rhodes House, Middleton
Brogden, Alexander, M.P....Ulverston
Bromley, James...Forton, Garstang
Bromley, John...Lancaster
Brooks, J. M....7, Charlotte Street, Manchester
Brown, Edward...Worsley Grange, Manchester
†Butler, Thomas...Dalton-in-Furness
Calvert, Dr. F. C....Bradford, Manchester
†Cameron, A. H. F....Sheil Road, Liverpool
Carruthers, G. B...Westbourne Terrace, Lancaster
Castellain, Alfred...Liverpool
†Chadwick, F....The Hermitage, Grimsargh, Preston
Chandler, Henry...Salford, Manchester
Clare, C. Leigh...Higher Broughton, Manchester
Clarke, W. B...Barwickstead, Beckermet, Carnforth
Clifton, Thomas H....Lytham Hall, Lytham
†Clowes, Edmund....Carnforth, Lancaster
†Cookson, John...The Firs, Stretford
Cragg, W. Smith...Arkholme, Lancaster
Cranke, John...Fountain Street, Ulverston
Craven, James...Whalley Range, Manchester
Critchley, Walter R....Salwick Hall, Preston
†Cropper, E. W....Moss Bank, Augkton, Ormskirk
Cross, John...78, Cross Street, Manchester
†Cross, William A....Red Scarr, Preston
Crosse, Thomas B....Shaw Hill, Chorley
Croudson, John...Urswick, Ulverston
Culshaw, Joseph...Towneley, Burnley
Cunliffe, Major Ellis...Queen Street, Lytham
Davies, Benjamin...Hayton House, Chorley
Dawson, Edward...Aldcliffe Hall, Lancaster
†Derby, Earl of...Knowsley, Prescot
Derham, James...St. Thomas's Road, Chorley
†De Trafford, Sir H., Bt....Trafford Park, Manchester
Dobell, G C....10, North John Street, Liverpool
†Dodson, Charles E....Littledale Hall, Lancaster
†Drewry, George...Holker, Grange
†Earle, Frederic W....Edenhurst, Prescot
Eastwood, George...Healey Hall, Burnley
Eckersley, James...Burnt House, Chorley
Eckersley, Nathaniel...Standish Hall, Wigan
Eden, Peter...Cross Lane, Salford
Edmondson, T. G....Gresgarth Hall, Lancaster
†Entwistle, John S....Foxholes, Rochdale
Fair, Jacob W....Lytham, Preston
Fair, Thomas...Westwood, Lytham
Farnworth, J. K....Alderley Edge, Manchester
Farrer, James...Ingleborough, Lancaster
Feilden, Lt.-Col. H. M., M.P...Witton Pk., Blackburn
†Fenton, Joseph...Bamford Hall, Rochdale
†Fenton, William...Beaumonds, Rochdale
†Fielden, John...Dobroyd Castle, Todmorden
†Fielden, Joshua, M.P...Stansfield Hall, Todmorden
†Fielden, Samuel...Centre Vale, Todmorden
Follows, F. W....Cheetham, Manchester
Gaitskell, Jacob...Holmbrook, Carnforth
†Gamble, David...Gerrard's Bridge, St. Helen's
Garnett, Robert...Wyreside, Lancaster
Garnett, William...Clitheroe
†Garnett, William J....Quernmoor Park, Lancaster
†Gauthorp, H...Moorfield Ho., Widness, Warrington
Gerrard, John...Adlington, Chorley
Gillow, Richard C....Leighton Hall, Lancaster
†Gorst, William...Garston, Liverpool
Gould, John...Hyde Hall, Denton, Manchester
Graham, Rev. P....Turncroft, Darwen
Greatorex, Frederick...Queen's Brewery, Manchester
†Greenall, Gilbert...Walton Hall, Warrington
†Greene, Thomas...Whittington Hall, Lancaster
†Gregson, Matthew...Toxteth Park, Liverpool
Grundy, Edward S....Reddish Hall, Warrington
†Hannay, R....Springfield, Ulverston
Hare, Theodore J....Crooke Hall, Chorley
Hargreaves, E. H....Kirkham
Harper, William...Bury
†Harrison, W....Samlesbury Hall, Preston
Hart, John...Strangeways, Manchester
Harvey, C. W....Walton, Liverpool
†Haslam, John P....Gilmow House, Bolton
Hathornthwaite, W....Higher Wyersdale, Lancaster
Heaton, Captain H....Worsley, Manchester
†Hibbert, Henry...Broughton Grove, Grange
Hibbert, T. J...Broughton Grove, Newton-in-Cartmel
Holland, William...Pemberton, Wigan
Holliday, James...Lord Street, Liverpool
†Hollings, James C....Astley Bridge, Bolton
†Horton, William T....Skelmersdale Hall, Ormskirk
†Hubback, Joseph...Liverpool
†Hunt, George...Frenchwood, Preston
Hurst, Robert...Baillie Street, Rochdale
†Ingram, Joseph...The Elms, Sale, Manchester

Irlam, William...Ridgefield, Manchester
Jackson, James...6, Chapel Street, Preston
Jacson, C. R....Barton, Preston
†Kay, J. R....Bass Lane House, Bury
Kearne, J. H....Mintare Birkdale Park, Southport
†Kennedy, Myles...Burton Cottage, Ulverstone
Knight, John...Castle View House, Warrington
†Knowles, James...Eagley Bank, Bolton
Lambe, John...Hopefield, Eccles, Manchester
†Lewthwaite, G...Broad Gate, Broughton-in-Furness
Littledale, Harold...Liscard, Liverpool
†Marsland, W....Baguley Hall, Northenden
Mayman, B....Water Street, Liverpool
Meller, J. Galloway...Stretford, Manchester
†Mercer, William...Newton, Warrington
†Miller, T. Horrocks...Singleton, Kirkham
Milner, John...Myerscough, Preston
Morgan, T....Faulkner Street, Manchester
Moult, William...Knowsley, Prescot
†Mucklow, Edward...Castle Head, Grange
Muirhead, T....Victoria Street, Manchester
Murray, William...Lower Broughton, Manchester
†Musgrove, Edgar...West Town, Ormskirk
Neild, Henry...The Grange, Worsley, Manchester
†Newall, Henry...Hare Hill, Littleborough
†Ockleston, W. F....Cheadle, Manchester
†Ormerod, H. M....5, Clarence Street, Manchester
Park, James...Lighthurne, Ulverston
Parker, T. Townley...Charnock, Chorley
†Parkinson, Robert...Northenden, Manchester
Parr, Captain R. W...Grappenhall Hayes, Warrington
Pearson, F. F....Storrs Hall, Arkholme, Carnforth
†Peel, Jonathan...Knowlmere Manor, Clitheroe
Platt, Henry...Werneth Park, Oldham
Polding, James Bede...Burnley
Potter, T. B., M.P....Buile Hill, Manchester
Rawcs, John G....29, Dicconson Street, Wigan
†Rawstorne, L....Hutton Hall, Preston
Rayment, E. D....307, Vauxhall Road, Liverpool
†Reed, George, M.D....Royal Infirmary, Manchester
Reynolds, Osborne...Owens College, Manchester
†Reynolds, Dr. W...St. Michael's Hamlet, Liverpool
Richardson, R....Halewood, Liverpool
Richmond, Francis...Salford, Manchester
Ridgway, Thomas...Lymm, Warrington
Robinson, Dixon...Clitheroe Castle
Robinson, J....Huggart's Farm, Brindle, Chorley
Robinson, W....Darlington Lodge, Warrington
†Rothwell, R. R....Sharples Hall, Bolton
Rothwell, W. Talbot...Foxholes, Ellel, Lancaster
†Royds, A. Hudson...Falinge, Rochdale
†Royds, Henry...Wavertree, Liverpool
†Royds, Rev. John...Heysham Rectory, Lancaster
Ryder, T. B....57A, Church Street, Liverpool
Sandy, Thomas G....Cliviger Street, Burnley
†Satterfield, Joshua...Alderley Edge, Manchester
Schofield, W. Whitworth...Buckley Hall, Rochdale
Sharman, S....Little Crosby, Liverpool
Sillcock, R....Thornton Hall, Poulton-le-Fylde
Simpson, S....33, South King Street, Manchester
Singleton, John...Poulton le Fylde
Skirving, William...15, Queen Square, Liverpool
Slye, William W....Beaumont Castle, Lancaster
Smith, A. M'Kenzie...Kent Street, Liverpool
Smith, Charles...Kent Street, Liverpool
Smith, Joseph...Cable Street, Lancaster
†Smith, R. C....Parkfield, Swinton, Manchester
†Standish, W. S....Duxbury Park, Chorley
Stanley, Edward...The Height, Grange
Statter, T....Stand Hill, Whitefield, Manchester
Statter, T., jun....Stand Hill, Whitefield, Manchester
Steward, A. Benn...Newton Manor, Carnforth
Stocks, Charles...Cheadle, Manchester
Storey, George...Braunshawe House, Burnley
Storey, Joseph...Crosslands, Lancaster
Stunt, George...Springfield, Colston, Ulverston
Suttle, W. Benoni...Whalley Grange, Manchester
Talbot, W. Hawkshead...Hartwood Hall, Chorley
Tatton, T. W....Wythenshawe Hall, Northenden Manchester
†Taylor, Samuel...Eccleston Hall, Prescot
†Tempest, C. Henry...Upland, Preston
Tinne, John A...Briarley, Aighurth, Liverpool
Townend, John...Shodsworth Hall, Blackburn
Vickers, Thomas...Cheetham Hill, Manchester
†Wadham, E....Mill Wood, Dalton in Furness
Walker, O. Ormerod...Bury
Walker, William T....Clapham, Lancaster
†Webb, Charles J....Brooklands, Ormskirk
†Whalley, C. L....Richmond House, Lancaster
Whitworth, H....96, King Street, Manchester
Whitworth, Sir J....Chorlton Street, Manchester
Willacy, Robert...Penwortham Priory, Preston
†Willis, H. R. D'Anyers...Halewood, Liverpool
Wilson, T. Newby...The Landing, Ulverston
Wilson, William...Oubas Hill, Ulverston
†Withington, T. E....Culcheth Hall, Warrington
Wood, James...Oaklands, Walton, Liverpool
Wood, James...Haigh Hall, Wigan
†Woodburne, Thomas...Thurston Ville, Ulverston
Woodhouse, John...Skale Hall, Lancaster
Worrall, Edward...Whalley Range, Manchester

LEICESTERSHIRE.

Members.

†Allen, John...Knighton, Leicester
Allen, Joseph, jun....19, Seymour Street, Leicester
Allen, Thomas...Thurmaston, Leicester
Angrave, Thomas C....East Leake, Loughborough
Ardron, John...Queniborough, Leicester
Arkwright, A. W.. Broughton Astley Ho., Lutterworth
Arthur, Col. Charles...Misterton Hall, Lutterworth
Badcock, Rev. T....Fleckney, Market Harborough
Bailey, Edward...Leicester
†Barwell, Thomas...Leicester
Beale, Joseph...Wolsey Grange, Hinckley
†Berners, Lady...Keythorpe Hall, Leicester
Berry, Edmund...Ashley, Market Harborough
Bolton, J. A., M.D....Belgrave Gate House, Leicester
Brewitt, T. B....Sanham House, Melton Mowbray
Brook, Charles...Enderby Hall, Leicester
†Brooke, Sir W. de Capel, Bt....The Elms, Market Harborough
Brown, Henry...Ashby-de-la-Zouch
†Bruxner, Rev. G. E., M.A....Thurlaxton, Hinckley

Bryan, Frederick T....Humberstone, Leicester
Buckley, John N....Loughborough
Carver, Robert...Ingarsby, Leicester
Catlin, R. Edgar...Humberston Road, Leicester
Chapman, Captain W. H....Enderby, Leicester
Cheney, Edward H...Gadsley Hall, Melton Mowbray
Clarke, John Sanders...Peatling Hall, Lutterworth
Coleman, G. W....Great Glen, Leicester
Collins, Charles...Burbage, Hinckley
Cooper, Alfred Allen...The Hall, Wigston, Leicester
Creswell, R. W....Ravenstone, Ashby-de-la-Zouch
Croft, John..Dalton, Saddington, Market Harborough
Davis, John...Wykin Hall, Hinckley
Doubleday, E.,M.D...Long Clawson,Melton Mowbray
Eggleston, Edward J....Great Peatling, Lutterworth
Eggleston, William...Wigston Magna, Leicester
Ellis, James...Glenfield, Leicester
Everard, William...Narboro', Enderby, Leicester
Farnham, E. B....Quorndon House, Loughborough
Fisher, E. Knapp...Market Harborough
Foster, John...Copson Lodge, Hinckley
Fowke, Sir F. T., Bart....Lowesley Hall, Leicester
Freer, Charles T....The Coplow, Billesdon, Leicester
Freer, Jesse...Rothley, Loughborough
Goodchild, Philip...Glen Parva, Leicester
Hack, Matthew...Leicester
Hadden, A....The Old Parks, Ashby-de-la-Zouch
Hall, W. Henry...Glen Parva, Leicester
Hamel, A. John...Lancaster Place, Leicester
†Hames, John...Rotherby, Leicester
Harding, Charles...Knighton, Leicester
Harris, George Shirley...Leicester
Harris, John Dove, jun....Knighton, Leicester
Harris, Samuel...West Coates Grange, Leicester
†Harrison, John...The Willows, Leicester
Hassall, Joseph...Great Wigston, Leicester
Hazlerigg, Sir A. Grey, Bart...Noseley Hall, Leicester
Henson, William...Burtonfields, Hinckley
Herbert, Thomas...86, Welford Road, Leicester
Herrick, W. P....Beau Manor Park, Loughborough
Hill, Rev. Abraham...Spa Place, Leicester
†Hoskyns, Rev. H. J....Blaby Rectory, Leicester
†Humphreys, Henry...Wood House, Loughborough
Hunt, Rowland...Kibsworth Hall
Hunt, William...Leicester
Ingram, Thomas...Great Wigston, Leicester
Innocent, A....Kibworth Beauchamp, Leicester
Johnson, T. F....Stoneygate, Leicester
Johnson, Walter F....Leicester
Johnson, W. H....Old Hall, Braunston, Leicester
Kemp, Francis...Saddington, Market Harborough
Knight, E. W....Newton Harcourt, Leicester
Knight, Captain Gregory...Glen Parva, Leicester
Knight, Major Joseph...Glen Parva, Leicester
Lacey, Robert...Hoton, Loughborough.
Leadbeater, J. B.. Thorpe Satchville, Melton Mowbray
Lowe, Thomas F....South Croxton, Leicester
Miles, Roger Dutton...Keyham, Leicester
Miles, Thomas...Keyham, Leicester
Mudford, Joseph...Hoe Fields, Hinckley
†Morris, Thos., jun....Walcote Fields, Lutterworth
†Mowbray, Captain...Overseal, Ashby-de-la-Zouch
Nuttall, Thomas...Manor House, Beeby, Leicester
Oldacres, Matthew...Clipston, Market Harborough
Owston, Hiram A....Great Wigston, Leicester
†Paget, G. E....Sutton Hall, Loughborough
†Paget, T. T....Humberstone, Leicester
Painter, Robert...18, Gallowtree Gate, Leicester
Pearson, Captain W....Walcote, Lutterworth
Pilgrim, S. C....The Outwoods, Hinckley
Pochin, Capt., R.N....Braunston House, Leicester
Reynolds, J. B....Lubbesthorpe, Leicester
Richards, W....Belgrave, Leicester
Robinson, Alfred...Gas Works, Leicester
†St. Maur, Lord A....Burton, Loughborough
†Salt, William H....Kirby Frith, Leicester
Sarson, John...Welford Place, Leicester
Scott, W....Normanton Turville, Hinckley
Shakespears, John...Copson Magna, Hinckley
†Sharman, Warren...Melton Mowbray
Shaw, George, M.D....Leicester
Simpkin, Joseph...Narborough, Leicester
Simpkin, Thomas H....Hoby, Leicester
Slee, Henry W....Leicester
Smith, John T....Kibworth, Leicester
Smith, Percy L....Gt. Peatling Lodge, Lutterworth
Spencer, Francis...Claybrooke, Lutterworth
Stone, Joseph C....Rowley Fields, Leicester
Stone, N. C....Aylestone Hall, Leicester
†Stratford, H. S....Thorpe Lubenham, Market Harborough
Straton, Rev. G. W....Aylestone, Leicester
†Tailby, W. Ward...Skeffington Hall, Leicester
Taylor, John...Belgrave Gate, Leicester
Taylor, Thomas S....Leicester Frith, Leicester
Taylor, William...37, West Street, Leicester
Thorpe, William...Nailstone, Hinckley
†Tryon, Richard...Loddington Hall, Leicester
Vaughan, G. L....Belmont Villa, Leicester
†Voile, Thomas...Frolesworth, Lutterworth
Wale, Henry...Woodlands, Narborough
Warner, Thomas...The Abbey, Leicester
Wartnaby, Mrs....Market Harborough
Woodcock, H. C....Rearsby, Leicester
Woodroffe, W. Solomon..Normanton, Loughborough
Worswick, Captain...Normanton Hall, Hinckley
Wright, Thomas...Wanlip, Leicester
Wright, William...Shoby Priory, Melton Mowbray

LINCOLNSHIRE.

Governors.

Chaplin, Henry, M.P....Blankney Hall, Lincoln
†Cholmeley, Sir M. J., Bt., M.P....Colsterworth
†Dysart, Earl of...Buckminster Hall, Colsterworth
Kesteven, Lord...Casewick, Stamford
†Nisbet-Hamilton, Rt. Hon. R. A...Bloxholme Hall
†Rutland, Duke of, K.G....Belvoir Castle, Grantham

Members.

†Alington, G. M....Swinhope House, Grimsby
Amcotts, Colonel, M.P....Hackthorn Hall, Lincoln
Ashton, T. M....Deeping St. Nicholas, Spalding
Bartholomew, W....Waddington Heath, Lincoln
Battle, John R....Potter Hanworth, Lincoln

Bell, Ancill...Manor House, North Kyme, Sleaford
Beridge, Rev. Basil...Algarkirk, Spalding
†Bettinson, Richard...Cawthorpe, Bourne
Bland, George...Coleby Hall, Lincoln
Bonnall, John...Grantham
Borman, Joseph...Irby, Caistor
Borman, Luke...Barnoldby-le-Beck, Grimsby
Boucher, Charles...Caenby Hall, Market Rasen
Bramley, Charles...Fiskerton Hall, Lincoln
Briggs, D. Grant...Calcethorpe Manor, Louth
Brown, Pereira...Glentworth Hall, Lincoln
Buddicom, Rev. R. J....Morton, Gainsborough
Burgess, John...Edenham, Bourne
Burkill, E. W...Winteringham, Brigg
Byron, John...Kirby Green, Sleaford
Caborn, Richard S....Denton, Grantham
†Calvertt, J. S...Tothill Manor House, Alford
Campain, Joseph George...Cowbit, Spalding
Campain, S. W....Deeping St. Nicholas, Spalding
Cartwright, T....Pillar Farm, Dunston, Lincoln
Casswell, George...Gosberton, Spalding
Casswell, John Henry...Laughton, Folkingham
Cave, Henry Haddon...Brigg
†Clarke, Charles...Ashby-de-la-Lound, Sleaford
Clarke, John Algernon...Long Sutton
†Clayton, Nathaniel...Newland House, Lincoln
Coates, Thomas...Ravendale, Grimsby
Cole, Robert...Belmont, Wragby
Conington, Clement...Hagworthingham, Spilsby
Coultas, James, jun....Spittlegate, Grantham
Coupland, John G....Freeston, Boston
†Crawley, John, jun....Gosberton Fen, Spalding
Crawley, Lewis...Keightley House, Holbeach Marsh
†Crofts, Rev. C. D....Caythorpe Rectory, Grantham
Dalton, James...Fillingham Manor, Lincoln
Davy, John...Owersby, Market Rasen
†Day, Charles...Easton, Stamford
†Day, Nevile...Easton, Stamford
†Dixon, John William...Caistor
†Dixon, Thomas Parkinson...Caistor
Duckering, R. E....Northorpe, Kirton Lindsey
Dudding, Henry...Panton House, Wragby
Dudding, William...Lambcroft, Louth
Ealand, John Robert...Aisthorpe, Lincoln
Eaton, Charles O....Tolethorpe, Stamford
†Ellison, Major R. G....Boultham Hall, Lincoln
Epton, Robert J....Newball, Lincoln
Everington, W., jun....Skegness, Burgh-le-Marsh
†Exeter, Marquis of...Burghley House, Stamford
Fane, Colonel F....Fulbeck Hall, Grantham
†Fieldsend, Charles R....Kirmond, Market Rasen
Fletcher, Thomas...Deeping St. Nicholas, Spalding
†Foster, H. Y. West...Crauwell Lodge, Sleaford
Foster, William...Canwick House, Lincoln
Fox, William...Brook Farm, Dunston, Lincoln
Frankish, William...Limber Magna, Ulceby
†Fytche, J. Lewis...Thorpe Hall, Elkington, Louth
†Garfit, Arthur...Scothern, Lincoln
†Gibson, John Kirk...Ingleby, Lincoln
Grantham, Major H. V....West Keal Hall, Spilsby
†Greetham, John...Stainfield Hall, Wragby
Greetham, William...Stainfield Hall, Wragby
Grundy, George...Misterton, Gainsborough
Hack, Algernon...Buckminster, Grantham
†Handley, Major B....Pointon House, Folkingham
Harris, Edward...Horbling Vicarage, Folkingham
Hayes, Henry...Stamford
†Heneage, Edward...Hainton Hall, Wragby
Hessletine, W...Beaumont Cote, Barton-on-Humber
Hickson, Richard...Hougham, Grantham
Hilliam, Captain T....Willesby Hall, Spalding
Hobson, John George...Curlew Lodge, Long Sutton
Holland, James...Deeping St. Nicholas, Spalding
Holland, John Wells..Deeping St. Nicholas, Spalding
†Horner, James B....Lincoln
Hornsby, Richard...Spittlegate, Grantham
Howard, E. J....Rise Farm, Nocton, Lincoln
Howard, R. G. F....Temple Bruer, Lincoln
Hunt, William...Deeping St. Nicholas, Spalding
†Hurdman, J. E...Mareham le Hill, Horncastle
Hutton, William...Gate Burton, Gainsborough
†Jarvis, G. K....Doddington Hall, Lincoln
Jeffrey, G. E....Rutland Works, Stamford
Jekyll, John...Newland, Lincoln
Johnson, G. W....Ufford, Stamford
Keyworth, H. J....Cottesford Place, Lincoln
†Keyworth, J. R. H....Greestone House, Lincoln
†King, John R....North Ormsby, Louth
Kingston, Samuel...Spalding
Kirk, Charles...Sleaford
Kirkby, Thomas...Cuxwold, Caistor
Kirkham, Thomas...Biscathorpe House, Louth
Laxton, Clement...Pinchbeck West, Spalding
Lister, Charles...Coleby Lodge, Lincoln
†Livesey, Rev. T....Stourton Hall, Horncastle
†Locock, Edmund...South Elkington, Louth
Lowe, John...Ryhall, Stamford
†Lucas, Rev. C. H....Edith Weston, Stamford
†Lucas, Lieut. Col. R....Edith Weston, Stamford
Lynn, John...Church Farm, Stroxton, Grantham
Mackinder, Harwood...Langton Grange, Spilsby
Mackinder, Herbert...Mere Hall, Lincoln
†Maddison, G. Wilson...Partny, Spilsby
Marris, Thomas...Ulceby
†Marshall, Frederick C....Riseholme, Lincoln
Marshall, James...Gainsborough
Marshall, William F....Branston Villa, Lincoln
Martin, David...Wainfleet
†Martin, George...Hubert's Bridge, Boston
†Martin, James...Wainfleet
†Martin Robert...Asterby, Horncastle
Mason, Richard...Keddington, Louth
Melville, Hon. A. Leslie...Branston Hall, Lincoln
†Melville, A. S. Leslie...The Longhills, Lincoln
Melville, C. Leslie...Branston Hall, Lincoln
Morley, R. Newcombe...Leadenham, Grantham
Mundy, C. J. Massingberd..Old Bollingbroke, Spilsby
†Nainby, C. M....Barnoldby-le-Beck, Grimsby
Nelson, John...Kettleby Thorpe, Brigg
†Nelson, John...Wytham House, Louth
Nidd, C. W....Creeting Manor Farm, Stamford
North, Charles...South Thoresby, Alford
†Packe, G. Hussey...Caythorpe Hall, Grantham
Paddison, Edward...Ingilby, Lincoln
†Palmer, Rev. P. H.....Wolsthorpe, Grantham
Pears, John...Mere, Lincoln

Pickworth, W....Deeping Bank, Crowland
Pigott, William...Brigg
Pinder, Thomas...Barroby, Grantham
†Pogson, F. M....Caythorpe, Grantham
Pogson, S. M....Anwick, Sleaford
Porter, J. T. B....Lincoln
Pratt, Frederick...Greatford, Stamford
Proctor, H. M....Hill House, Wykeham, Spalding
Richardson, John...Asgarby, Spilsby
Robey, Robert...Canwick Road, Lincoln
Robinson, Henry...Hough-on-the-Hill, Grantham
Robinson, R., sen....Sedgebrook, Grantham
Robson, James...Brackenborough, Louth
Ruston, Joseph...Lincoln
†St. Albans, Duke of...Redbourn Hall, Brigg
Searson, Robert...Cranmore Lodge, Market Deeping
†Seels, Henry John...Wainfleet Hall
Sharpe, William...Mavis Enderby, Spilsby
†Sharpley, Coates...Kelstone Hall, Louth
†Sharpley, Henry...Acthorpe, Louth
†Sharpley, Isaac...Boswell House, Louth
Sheffield, Sir R., Bart....Normanby, Brigg
Shipman, Thomas...Croxton Lodge, Grantham
†Short, A. L. H....Edlington, Horncastle
†Shuttleworth, Alfred...Heighington Hall, Lincoln
†Shuttleworth, Joseph...Hartsholme Hall, Lincoln
†Sills, W....Casthorpe, Grantham
†Simonds, J. Cabourne...Fishtoft, Boston
†Skelton, E. Dunkley...Sutton Bridge
Skipworth, G. B....Moorton House, Caistor
Slator, Thomas...Market Place, Boston
Smith, John...Deeping High Bank, Crowland
Snow, Cyprian...Manor Farm, Dunston, Sleaford
Snow, James M....Metheringham, Sleaford
Sowerby, Francis...Aylesby, Great Grimsby
Spurr, George...Boston
Stainton, John...Dalby, Spilsby
†Stanhope, J. Banks...Revesby Abbey, Boston
Swallow, W....Chapel Farm, Barton-on-Humber
†Thorold, Richard...Weelsby Hall, Grimsby
†Tomlinson, Bruce...Asgarby, Sleaford
†Torr, William...Aylesley Manor, Great Grimsby
Travers, P. F....Great Carlton, Louth
Turner, John...The Grange, Ulceby
†Turnor, Christopher...Stoke, Grantham
†Turnor, Edmund, M.P....Panton Hall, Wragby
Tuxford, J. S....Skirbeck, Boston
Tuxford, Weston...Boston
Webster, James...Peakirk, Market Deeping
Welby, J. Earle...Allington Hall, Grantham
Welby, W. Earle, M.P....Newton Ho., Folkingham
Welby-Gregory, Sir G. E., Bt....Denton Hall, Grantham
West, John...Melton Ross, Brigg
Whitehead, William...Etton, Market Deeping
Wilson, Edward H....Hagworthingham, Spilsby
Wilson, Francis...Ludford, Market Rasen
†Wingfield, J. H. Lee...Tickencote Hall, Stamford
†Winn, Rowland, M.P....Appleby Hall, Brigg
†Wood, Bennett W....Humberstone, Great Grimsby
Wright, Robert...Nocton Heath, Nocton
†Wyles, Robert...Little Ponton, Grantham
†Yarborough, Earl of...Manby Hill, Glanford Bridge
†Yates, Henry...North Parade, Grantham

MIDDLESEX.

Governors.

Allcroft, John D....Harlington
†Cambridge, H.R.H. The Duke of, K.G....Gloucester House, Piccadilly
†Fuller, Francis...3, Whitehall Gardens, S.W.
Gibbs, B. T. Brandreth...47, Half Moon St., W.
†Harcourt, G. Simon...35, St. George's Square, S.W.
Rigg, Jonathan..4, Chester Place, Hyde Park Square

Members.

†Acworth, Nathaniel B....The Hook, Northaw
Addison, John..6, Delahay Street, Westminster, S.W.
Alisou, John...90, Lancaster Gate, W.
†Allender, G. M....6, Dawson Place, Bayswater, W.
Arnold, James...35, West Smithfield, E.C.
Arnott, T. Reid..Bramshill, Harlesden Green, N.W.
Badcock, P....Aldridge Road Villas, Westbourne Pk.
Baillie, William H....43, Norfolk Square, W.
Baily, John...113, Mount Street, Berkeley Square, W.
Baker, C. N..Half Moon Passage, Gracechurch St., E.C.
Barclay, G. R....Oxford and Cambridge Club, S.W.
†Barker, H. B. R....University Club, Suffolk St., W.
Barnett, John...Coleraine House, Stamford Hill
Batt, William Henry...West Drayton, Uxbridge
Beale, E. J....237, High Holborn, W.C.
Beauchamp, Charles D....93, Lansdowne Road, W.
†Begg, David, M.D....Canons Park, Edgeware, N.W.
†Birkbeck, Robert...20, Berkeley Square, W.
Birt, Jacob...23, Sussex Gardens, Hyde Park, W.
Blackstone, J...1, Gloucester Rd., Regent's Pk., N.W.
Blane, Colonel Robert...The Oaks, Sunninghill
†Blanshard, Richard...53, Chancery Lane, W.C.
†Blyth, James...24, Hyde Park Gardens, W.
Boards, Edward...Edmonton, N.
Boards, William...Edmonton, N.
Bowler, Wm. Anthony...Craven Street, Strand, W.C.
Bradford, Thomas...63, Fleet Street, E.C.
Bramwell, F. J..37, Gt. George St., Westminster, S.W.
Brown, Professor G. T....7a, New Cavendish St., W.
Buckland, Thomas, jun....Wraysbury, Staines
Burgess, William...Holborn Viaduct, E.C.
Burney, George...Millwall, E.
Caird, James...3, St. James's Square, S.W.
†Calvert, Frederick...38, Upper Grosvenor Street, W.
†Cardwell, E. H....11, Cromwell Place, S.W.
Carson, J. A....La Belle Sauvage Yard, Ludgate Hill
†Chambers, W...United Univ. Club, Pall Mall, S.W.
Chapman, Thomas...14, Cockspur Street, S.W.
†Claridge, William...51, Brook Street, W.
Clarke, T. Truesdale...Swakeleys, Uxbridge
Clive, Lieut. Col. the Hon. G. W. Windsor, M.P....53, Grosvenor Street
Clowes, Wm....51, Gloucester Terrace, Hyde Pk., W.
Clutterbuck, R....8, Great Cumberland Place, W.
Clutton, Henry...9, Whitehall Place, S.W.
Clutton, John...9, Whitehall Place, S.W.
†Clutton, John Henry...9, Whitehall Place, S.W.
Clutton, Robert...9, Whitehall Place, S.W.
†Cobb, Henry...53, Lincoln's Inn Fields, W.C.
Corbet, H....Farmers' Club, Salisbury Square, E.C.
Cottam, George H....Old St. Pancras Road, N.W.

Couchman, J. W....Pembury Road, Tottenham
Cowper, E.A., C.E....6, Gt. George St. Westminster
Craigie, P. G..Hartley Ho., Lower Heath, Hampstead
Crisp, Edwards, M.D....42, Beaufort Street, Chelsea
Crutchley, P. H....Sunninghill Park, Staines
Cuff, J. H....New Cattle Market, Islington, N.
Daubeny, Robert.2, King's Bench Walk,Temple, E.C.
†Davis, R....9, St. Helen's Place, Bishopsgate, E.C.
Day, Thomas...22, Dorset Street, Baker Street, W.
De Pass, Daniel...9, Delamere St., Westbourne Sq.
†Derham, William...Tottenham
De Salis, Rev. Henry J....Portnall Park, Staines
†De Wezele, Count G....25, Eaton Square, S.W.
†Dilke, Sir C. W., Bt., M.P....76, Sloane Street, S.W.
Driver, Robert Collin...4, Whitehall, S.W.
†Druce, S. B. L....New University Club, S.W.
Dudgeon, J....8, Tavistock Square, W.C.
Dunlop, A. M....1, Westminster Chambers, Victoria Street, S.W.
†Dunn,Thos...1,Prince's Gardens,S.Kensington, S.W.
†Elliot, J. Lettsom...10, Connaught Place, W.
Erichson, H. G....7, Gt.Winchester St. Buildings, E.C.
Ernest, Henry...17, Salisbury Street, Strand, W.C.
†Fellowes, James...6, Bryanston Square, W.
†Field, Henry.National Club,Whitehall Gardens,S.W.
†Field, William...224, Oxford Street, W.
Finch, Jacob...59, Mark Lane, E.C.
†Fitzwygram, Lieut.-Col. F....4, Portland Place, W.
†Fletcher, John Philip...Sunbury
†Freebody, W. Yates...239, Hackney Road, N.E.
Fretwell, Charles H....Belle Isle, York Road, N.
Gadsby, Alfred...George Yard, Bouverie Street, E.C.
†Gibbs, Henry H..St. Dunstan's, Regent's Park, N.W.
Gibbs, Thomas...26, Down Street, Piccadilly, W.
Glasier, William R....41, Charing Cross, S.W.
†Gooch, John V....Reform Club, Pall Mall, S.W.
Gosling, Thomas G....15, Portland Place, W.
Graham, Walter...West Drayton, Uxbridge
†Grant, Colonel W. L....22, Hyde Park Street, W.
Grantham, R. B....22, Whitehall Place, S.W.
Greening, E. Owen...35, King St., Westminster, S.W.
Grenfell, A. Riversdale...Travellers' Club, S.W.
†Grey, The Hon. Sir F. W. G., C.B..Lynwood, Staines
Grosvenor, Lord Richard, M.P....76, Brook Street, W.
Gurney, Right Hon. Russell, M.P...8, Palace Gardens, Kensington, W.
Haig, G. A....7, Argyle Street, Regent Street, W.
Hall, J. Orde...1, Brunswick Row, Queen's Sq., W.C.
Hammick, H. H....11, Pall Mall, S.W.
Harcourt, Colonel...5, Carlton Gardens, S.W.
Harrison, J. T....Thornhill, Castlebar, Ealing
†Haslewood, L. R..194,Gresham Ho.,Old Broad St.E.C.
†Hay, C. A....17, York Terrace, Regent's Park, N.W.
†Hayne, John...24, Gloucester Sq., Hyde Pk., N.W.
†Heseltine, E....6A, Austin Friars, E.C.
†Heywood, Jas...26, Palace Gardens, Kensington, W.
†Hibbert, P. E. T....14, Hill Street, W.
†Hibbert, Washington...14, Hill Street, W.
Hicks, Leonard H....Paddock Lodge, Kentish Town
Hill, Henry...52, Queen's Gate Terrace, S.W.
Hilliard, W. E....Cowley House, Uxbridge
†Holman, Stephen...Spring Lodge, Ealing
Jessop, Joseph...Grove Farm, Chiswick
†Jodrell, Sir E. R., Bart....61, Portland Place, W.
Johnson, A. H....Gunnersbury House, Isleworth
Johnson, A. H., jun....Hanger Hill Farm, Ealing
Johnson, C. W....36, Mark Lane, E.C.
Johnson, E. Lionel, jun....Moffat House, Bow Road
†Johnson, R. W....49, Queen's Gate Gardens, W.
Johnstone, E....3, King's Bench Walk, Temple, E.C.
†Jonas, Henry...4, Whitehall, S.W.
Keir, Capt. G. L..33, Pembroke Road, Kensington, W.
Key, Sir Kingsmill G., Bart....Holborn Viaduct, E.C.
King, William...Denham, Uxbridge
Kirkland, Sir John...17, Whitehall Place, S.W.
Labalmondiere, G....32, Craven Street, W.C.
†Laurie, A....10, Charles Street, St. James's, S.W.
†Lees, Charles...23, Philpot Lane, E.C.
†Locock, Sir Charles, Bart....26, Hertford Street, W.
†Locock, Frederick...9, St. James's Place, S.W.
†Longbourne, W. F...4, South Sq., Gray's Inn, W.C.
Lott, John...156, Victoria Park Road, N.E.
Lucan, Earl of...36, South Street, Park Lane, W.
Macadam, C. T....109, Fenchurch Street, E.C.
McDougall, James T....158, Leadenhall Street, E.C.
Mackay, A. S. H....Ashton Villa, Ealing
Mahon, Viscount, M.P....48, Chester Square, S.W.
†Malcolm, Major-General...67, Sloane Street, S.W.
†Malcolm, John...7, Great Stanhope Street, W.
Mansell, Edward...27, Great George Street, S.W.
Maple, John...Bedford Lodge, Hampstead, N.W.
†Marjoribanks, E., jun....59, Strand, W.C.
Markby, J. R....9, Whitehall Place, S.W.
Marshall, Rev. C....9, South St., Finsbury Sq., E.C.
†Martin, F. B. P...Oxford and Cambridge Club, S.W.
Maude, Col. G. A., C.B....Hampton Court Stud Farm
†Meyer, James...Forty Hall, Enfield
Milburn, R....76, Church Lane, Whitechapel, E.
Monro, M. M....Enfield
Moore, James...11, Upper Berkeley Street, W.
Moore, J....Northumberland House, Charing Cross
†Morrison, F., 35, Cromwell Houses, S. Kensington, W.
Morton, Francis....36, Parliament Street, S.W.
Morton, J. Chalmers...Harrow, N.W.
†Morton, J. D....19, Parliament Street, S.W.
†Murray, A....74, St. George's Road, Pimlico, S.W.
Nash, Daniel...4, York Gate, Regent's Park, N.W.
Nicholay, J. A....West Drayton
†Nicholson, W....4, Sussex Square, Hyde Park, W.
Nickisson, John...Stonebridge Park, Willesden
Noyes, T. H....13, Gate Street, Lincoln's Inn, W.C.
†Oakley, Christopher...10, Waterloo Place, S.W.
Oakley, John...10, Waterloo Place, S.W.
Odams, James...109, Fenchurch Street, E.C.
Owens, Samuel...Whitefriars Street, E.C.
†Parkinson, John...37, Gresham House, E.C.
Pelham, F. T...Norfolk Farm, Windsor Park, Staines
Perkins, Loftus,...6, Seaford St., Regent Square, W.C.
Perry, Sir T. Erskine, Bart....36, Eaton Place, S.W.
†Peto, Sir Morton, Bart....9, Victoria Chambers, Victoria Street, S.W.
Phillips, H. R....Willesden Paddocks, Kilburn
Phillips, Maj.-Gen. Sir T..... Senior United Service Club, S.W.
Phillips, T. E....37, Wilton Place, S.W.
†Phillpotts, Thomas...Junior Carlton Club, S.W.

†Pickford, W....148½, Fenchurch Street, E.C.
Pilgrim, C. H....Virginia Water, Staines
Pole, Sir Van Notten P., Bt...59, Gloucester Pl., W.
Powis, Charles...60, Gracechurch Street, E.C.
Pritchard, William...Royal Veterinary Col., N.W.
Proctor, M. M....49, Thornhill Square, Barnsbury
Purser, Edward...116, Fenchurch Street, E.C.
Ramsey, John...9, Endsleigh Street, W.C.
Randolph, Lieut. Col....76, Chester Square, S.W.
†Rivington, Harry...22, Finsbury Square, E.C.
Robinson, Sir J. S., Bart....20, Park Lane, W.
†Roebuck, J. A....19, Ashley Pl., Victoria St., S.W.
Rotton, Richard...3, Boltons, Brompton, S.W.
†Rucker, Martin D....115, Leadenhall Street, E.C.
Sanderson, James...11, Pall Mall East, S.W.
†Sandford, G. M. W...33, Hertford St., May Fair, W.
†Schwann, F. S....Rosslyn Manse, Hampstead
Scott, Col. the Hon. C. G....79, Eaton Square, S.W.
Scott, T. C...King's Arms Yard, Moorgate St., E.C.
Scott, Louis Guy...79, Eaton Square, S.W.
Shackle, Thomas...Hayes, Uxbridge
Shaw, C. H....Woodbine Cottage, Hackney, N.E.
†Sherhorn, Francis...Bedfont, Hounslow
†Simonds, T....41, West Smithfield, E.C.
Simpson, A...Chiswell Street, E.C.
†Simpson, Pinder...34, Saville Row, W.
Sladen, D. B.... 2, King's Arms Yard, E.C.
Sladen, St. Barbe... 14, Parliament Street, S.W.
†Smith, Edward J....16, Whitehall Place, S.W.
†Smith, J. Heseltine... 24, Essex St., Strand, W.C.
Smith, M. T....13, Upper Belgrave Street, S.W.
Smith, R. B....Huxley Farm, Edmonton
Soames, D. W....Harrow Weald, Stanmore
Spencer, John...69, King William Street, E.C.
Squire, William...5, Coleman Street, E.C.
†Stanley, E. J....14, Grosvenor Square, W.
Stanley, W. H. Sloane...21, Curzon Street, W.
†Stephens, J....7, Westbourne Crescent, W.
Stevens, W. Carr...33, Mark Lane, E.C.
Stocker, J. P....93, Oxford Terrace, W.
Strafford, Henry...13, Euston Square, N.W.
Talbot, Hon. Col. W. P....Oakington, Harrow
Tattersall, Edmund...Albert Gate, S.W.
Taylor, James...Farmers' Club, Salisbury Sq., E.C.
Taylor, J. Wells...Chester Terrace, Regent's Pk., W.
Taylor, John, jun....51, Great Cumberland Place, W.
Taylor, R. Parker...Adelaide Place, London Bridge
Thackeray, Capt...Junior United Service Club, S.W.
Thompson, Major..Nottingham Place, Regent's Park
Thornhill, W. C. Clarke...Ickenham, Uxbridge
†Thornton, John...15, Langham Place, W.
Thursby, Lieut. Col....10, Green Street, W.
Thynne, F. G....11, Great George Street, S.W.
Tisdall, E. C...Holland Park Farm, Kensington, S.
†Tollemache, H. B...Junior United Service Club, S.W.
†Tomline, Colonel G., M.P...1, Carlton House Terrace, S.W.
Tompson, E. C. S....Dromenagh, Iver, Uxbridge
†Tooke, Rev. J. T. H....University Club, Suffolk Street, S.W.
Tuckett, P. D., jun....10A, Old Broad Street, E.C.
Tuson, R. V....Royal Veterinary College, N.W.
†Tyler, Sir James...Pine House, Holloway, N.W.
†Underwood, Joseph...5, Hyde Park Gardens, W.
Unite, John...291, Edgware Road, W.
Valpy, Richard...5, Rutland Gate, S.W.
†Veitch, H. J....Exotic Nurseries, Chelsea
†Wade, Richard...13, Seymour Street, W.
Walker, John L...71, Oxford Terrace, Hyde Pk., W.
†Walker, William Henry...38, Sackville Street, W.
Wall, T. Senior...120, Maida Vale, W.
Warington, Robert...Atlas Works, Millwall, E.
†Warner, George...Priory, Hornsey
Warner, Robert...8, The Crescent, Cripplegate, E.C.
Warner, W. H....99, Mount Street, W.
Watson, C., M.D...South Crescent, Bedford Sq., W.C.
Weatherby, James...6, Burlington Street, W.
†Webster, Charles...Cowley, Uxbridge
Welch, Alfred...Southall
†Wells, G. G....Junior United Service Club, S.W.
†Whitbread, S. C....49, St. George's Square, S.W.
White, Arnold W....12, Great Marlborough St., W.
†Whitehead, Jeffery...39, Throgmorton Street, E.C.
†Wicks, John...38, St. Luke's Road, W.
Williams, J. F....10, Queen's Sq., Bloomsbury, W.C.
Wing, T. Twining...17, Woburn Square, W.C.
Withers, S. H....242, Oxford Street, W.
Wood, C. A....Gt. Western Railway, Paddington, W
Wood, Walter A....77, Upper Thames Street, E.C.
†Wrench, Robert...39, King William Street, E.C.
†Wyndham, Hon. P., M.P....44, Belgrave Sq., S.W.
†Young, G....17, Trinity Square, Tower Hill, E.C.

MONMOUTHSHIRE.

Governor.

†Tredegar, Lord...Tredegar Park, Newport

Members.

†Bailey, Crawshay...Maindiff Court, Abergavenny
Batchelor, T. B....Maindee, Newport
†Berrington, Arthur D....Pant-y-Goitre, Newport
Bowles, Augustus...Abergavenny
Brewer, Tom Llewelyn...Dany Graig, Newport
Browning, S...Joint Counties Asylum, Abergavenny
†Cartwright, William G., M.A....Newport
Cartwright, William S....Stow House, Newport
Chandler, Charles T....Hays Gate, Chepstow
Clerk, Arthur...The Mead, Chepstow
†Cooke, Thomas Eborall...Newport
Croker, Joseph...Shirenewton Farm, Chepstow
†Darby, Abraham...Ebbw Vale Park, Newport
Elliott, Henry...7, Clifton Place, Newport
Evans, Warren...Llandowlais, Usk
†Evans, William...The Field, Newport
Firbank, Joseph...Newport
Fothergill, W....Cefnrhychdir, Tredegar
†Fox, Charles B....Malpas, Newport
Graham, W., jun....Newport
Graham, W. Benjamin, jun....Maindee, Newport
†Hamilton, John...Hilston Park, Monmouth
Harrby, David...Newport
Hawkins, Rev. Canon E...St. Woolas Vicarage, Newport
Herbert, Edmund...Llansantffraed, Abergavenny
Hewertson, Nelson...Newport

Hill, John...Llancayo, Usk
Holehouse, John...Gaer Hill, Chepstow
Homfray, Lorenzo A....Woodlands, Newport
Homfray, S....Glenuske Park, Caerleon, Newport
Homfray, W. H. W....Glenuske, Caerleon, Newport
†Howells, John Lewis...Blackwood, Monmouth
James, John...Lansoar, Caerleon
Jones, John...Pant-y-Goitre, Abergavenny
Lane, Walter...17, High Street, Chepstow
Lewis, T. F....Newport
Lister, Edward...Cefn Ila, Usk
†Mitchell, F. J..Llanfrechfa Grange,Caerleon,Newport
†Morgan, Col. the Hon. F.C..Ruperra Castle, Newport
Morgan, Roger...Llanellan, Abergavenny
Nelmes, W....Pembridge Castle, Monmouth
Ormerod, George...Sedbury Park, Chepstow
†Peacock, T. K....Ruperra Castle, Newport
Phillips, C....93, Commercial Street, Newport
Phillips, C. David...Newport
Pitt, Walter W....Whitchurch, Monmouth
Price, Henry...Undy, Chepstow
Price, W....New House, Caerleon, Newport
Pyhus, John...Court Farm, Magor, Chepstow
Raglan, Lord...Cefutilla House, Usk
Rees, W. G....Bryn Hedydd, Newport
Rees, W. Traharne...Holly House, Newport
Relph, G. R. Greenhow...Beech Hill, Usk
†Rolls, J. Allan...The Hendre, Monmouth
†Roper, Richard S....Newport
Stone, John S...Newport
†Stratton, R., jun...The Duffryn, Newport
Tucker, Edwin...Frogmore Street, Abergavenny
†Tyler, Capt. G. G....The Callow Hill, Monmouth
Williams, Rev. E. Turberville...Caldicot, Chepstow
Williams, Lewis...Redwick House, Chepstow
Woodall, Thomas...Dinham, Chepstow
Young, Edwin...Park House, Newport

NORFOLK.

Governors.

Wales, H.R.H. the Prince of, K.G....Sandringham
Buxton, Sir R. Jacob, Bt....Shadwell Court, Thetford
Cabbell, Benjamin Bond...Cromer Hall
†Duleep Singh, His Highness the Maharajah..Elveden Hall, Thetford
Kerrison, Sir E. Clarence, Bart...Brome Hall, Scole
†Leicester, Earl of...Holkham Hall
†Sondes, Lord....Elmham Hall, Thetford
Stafford, Lord...Cossey Hall, Norwich

Members.

†Abbott, Stephen...Castleacre, Swaffham
Aldous, James Arthur...Lingwood, Norwich
Allen, Rev. Dr...Shouldham Hall, Downham Market
†Amhurst, W. A. T....Didlington Park, Brandon
†Applewhaite, E....Pickenham Hall, Swaffham
†Aylmer, Hugh...West Dereham, Stoke Ferry
†Aylmer, John B....Fincham Hall, Downham
†Aylmer, Robert B....Westacre Abbey, Swaffham
†Back, J. A...The Old Hall, Hethersett,Wymondham
Barnard, Charles...Norwich
Barton, Gerard...Fundenhall, Wymondham
Bayning, Lady...Honingham Hall, Norwich
Beart, Charles...Stow Bardolph, Downham
Beauchamp, Sir T. W. P., Bt..Langley Hall, Norwich
Beck, Edmund...Sandringham, King's Lynn
†Bircham, William G...Dunton, Fakenham
†Bird, Rev. J. Waller...Foulsham Rectory
†Birkbeck, Henry...Norwich
Bishop, John...3, The Walk, Market Place, Norwich
Blake, Francis John...Norwich
Blomfield, John...Warham, Wells
Blyth, D'Urban...Great Massingham, Rougham
†Blyth, James...Weasenham All Saints, Brandon
Bond, Barnabas...Alburgh, Harlestone
†Bonner, Henry C....East Rudham, Rougham
Booth, Nathan, jun....North Delph, Downham
Boulton, W. S....Rose Lane, Norwich
Brereton, Rev. J. L....Little Massingham, Rougham
Brown, Benjamin...Thursford, Guist
†Brown, Thomas...Marham, Downham Market
†Budd, Thomas W....Shropham Hall, Thetford
Bulwer, William E. Lytton...Heydon Hall, Roepham
†Burrell, Charles...Thetford
Burroughes, H. N....Burlingham Hall, Norwich
Burroughes, Rev. J....Lingwood Lodge, Norwich
Case, Thomas H....Testerton Hall, Fakenham
Chambers, Thomas, jun....Colkirk Hall, Fakenham
Charteris, Hon. F....Eccles Hall, Attleborough
Cohen, James...Well Hall, King's Lynn
Coldham, H. W....Anmer, King's Lynn
Collyer, Rev. Canon R....Warham Rectory, Wells
Colman, Samuel...Willy Hall, Attleborough
Colman, T. H....Rockland St. Peter, Attleborough
Colman, J. James, M.P....Carrow House, Norwich
Cooke, Frederick T....Caston Hall, Attleborough
Cooper, W. W....Barnham, Thetford
Copeman, George...Dunham Lodge, Swaffham
Cresswell, Mrs. Gerard...Appleton Hall, King's Lynn
Crickmore, William...Seething, Brooke
Crowe, Daniel...Gaywood, King's Lynn
Custance, Hambleton, F....Weston House, Norwich
Davey, John G. Ellis...Horningtoft, Elmham
†Dewing, R....Carbooke, Watton, Norfolk
Digby, Rev. K....Tetteshall Rectory, Litcham
Dutchman, Durrant...Swaffham, Brandon
†Eaton, George...Spixworth, Norwich
England, Richard...Binham, Wells
Everett, F. H....Bridgeham, Thetford
†Everington, W. D....Dillington Hall, East Dereham
†Farrer, Edmund...Sporle, Swaffham
Fellowes, Robert...Shotesham Park, Norwich
Fellowes, Rev. T. L....The Vicarage, Honingham
Fison, Cornell...Thetford
†Fison, Cornell Henry...Thetford
Fitzroy, Lieut.-Col. H....Stratton Strawless, Norwich
†Frere, G. Edward...Roydon Hall, Diss
Fulcher, Thomas...Elmham Hall, Thetford
†Gilbert, Robert...Ashley Hall, Berghapton
†Gilbert, Robt., jun....Rockland St. Mary's, Norwich
†Gilbert, William A....Cantley, Acle
Giles, Henry...Croxton Park, Thetford
†Grafton, The Duke of...Euston, Thetford
Groucock, C....Stanfield Hall, Wymondham
†Gurdon, Brampton...Letton Hall, Shipdham

†Gurdon, Rev. Philip...Cranworth, Shipdham
Haines, Philip...Palgrave, Diss
Hammond, John...Bale, Thetford
†Hamond, Anthony...Westacre, Brandon
†Hardy, W. H. C....Letheringsett Hall, Holt
Hare, Sir T., Bart....Stow Hall, Downham Market
Harlock, Henry...Feltwell Grange, Brandon
Harvey, George...Belton, Great Yarmouth
†Holmes, Gervas...Brockdish Hall, Scole
Holmes, John...Globe Lane, Norwich
Howes, James...Chapel Field, Norwich
†Hudson, T. Moore...Castleacre, Brandon
Jones, George...Stow, Downham Market
†Jones, Sir W., Bart....Cranmer Hall, Fakenham
Kett, G. S....Brook House, Norwich
Kimberley, Earl...Kimberley, Wymondham
†King, John L....Thorpe Abbots, Scole Inn
Larkman, Robert...Belton Hall, Great Yarmouth
†Leeds, Robert...Wicken Farm, Castleacre, Brandon
Lee-Warner, H. J...Walsingham Abbey, Fakenham
†Lombe, Rev. H. E....Melton Hall, Wymondham
†Long, Kellett...Dunston Hall, Norwich
†Longe, J....Spixworth Park, Norwich
Lucas, George...Filby House, Norwich
Mann, John...Thornage, Thetford
Marriott, J. Lewis...Narborough, Brandon
Mathew, William...Knettishall, Harling
†Matthews, T....Newton, Castleacre, Brandon
†Middleton, Charles...Holkham
Middleton, W. W....Flitcham Abbey, King's Lynn
Mitchell, William...Northwold, Brandon
†Moore, T. William...Warham, Wells
Murton, Thomas...Kenninghall, Thetford
Muskett, Charles...Bressingham House, Diss
†Norris, William...Wood Norton, Fakenham
North, Charles...The Hall, Rougham
†Oldfield, Edmund...Fouldon Hall, Brandon
†Overman, Henry R....Weasenham, Fakenham
†Overman, John...Burnham, Sutton
†Overman, Robert...Edgmere, Walsingham
Parsons, John P....Honingham, Norwich
Pooly, Thomas...North Wold
†Read, Clare S., M.P...Honingham Thorpe, Norwich
†Read, G., jun....Barton Hall, Brandon
Reeve, James...Suetterton Hall, Thetford
Ringer, John...West Harling
†Ringer, T. F....Brancaster, Lynn
Rising, Robert...Horsey, Great Yarmouth
Rix, G....Gayton Thorpe, King's Lynn
Rose, Thomas...Melton Magna, Wymondham
Rous, Hon. W. Rufus...Worsted House, Norwich
Salter, W. P....The Abbey, Thetford
Scott, Joseph...Colney Hall, Norwich
Seppings, T. J... Wormegay Grange, King's Lynn
Shellahear, Samuel...Holkham, Wells
Stark, Michael J....Dukes Palace Bridge, Norwich
Stebbing, Henry...Stow Bedon Hall, Attleborough
†Stracey, Sir H. J., Bart., M.P....Rackheath Hall, Norwich
†Stuart, J. Windsor...Raynham Hall, Brandon
Suffield, Lord...Gunton Park, Norwich
Sumner, Rev. C. V. H....The Paddock, Swaffham
Taylor, T. L....Starston, Harleston
Tayton, William...Syderstone, Fakenham
Thorn, Charles...St. Giles Gate, Norwich
†Thornhill, Thomas...Riddlesworth Hall, Thetford
†Thornton, Thomas...Wereham, Stoke Ferry
Tompson, H. Kett...Witchingham Hall, Norwich
Tuck, Rev. G. R....Blofield, Norwich
†Turnbull, Rev. T. Smith...Blofield
†Turner, George...Barnham, Thetford
Tyrwhitt, Sir H., Bart....Ashwell Thorpe Hall
Varnell, G. W...Beech House, Belton, Gt. Yarmouth
Waite, J. N....Martham Hall, Great Yarmouth
†Walsingham, Lord...Merton Hall, Thetford
Watling, R. S....Scrathy Hall, Great Yarmouth
†Wellingham, John...East Walton, Lynn
Woods, Henry....Merton, Thetford
Wright, Robert...Queen Street, Norwich
†Wright, Thomas...North Runcton, Lynn
†Youngman, J. W....Westacre, Brandon

NORTHAMPTONSHIRE.

Members.

Aitkin, James...Peterborough
Ball, William...Rothwell, Kettering
Barford, William...Peterborough
Bayes, Charles...Kettering
Bearn, William...Finedon Hill, Wellingborough
†Beasley, J. Noble...Pitsford Hall, Northampton
Beasley, John...Brampton, Northampton
Berridge, Samuel...Croughton, Brackley
Bird, John, jun....Farcet, Peterborough
Boyer, William...Cottesbrook, Northampton
Branson, William C....Little Weldon, Wansford
Britten, Thomas...Little Billing, Northampton
†Burdett, E....Manor Farm, Lyveden, Thrapstone
†Cartwright, T. L. M....Newbottle, Brackley
Cartwright, General W....Weedon
Chapman, W....Apethorpe, Peterborough
Cooch, Mrs....Harleston, Northampton
Dalton, Rev. R....Kelmarsh, Northampton
Davison, John Perry...Easton Maudit, Northampton
Eden, F. Morton...Boughton House, Kettering
†Edwards, C. Bidwell...Minster Close, Peterborough
Edwards, T. F....Tanholt Farm, Eye, Peterborough
†Elliott, John...Chapel Brampton, Northampton
†Fitzwilliam, Hon. C. W., M.P..Alwalton, Peterboro'
†Fitzwilliam, Hon. G. W....Milton, Peterborough
Garratt, R. Lancefield...Thorpe Malsor, Kettering
Gaudern, John...Earls Barton, Wellingborough
Griffin, C. W....Werrington, Peterborough
Griffin, John...Borough Fen, Peterborough
Harrison, Rev. J. H....Bugbrook, Weedon
Harrison, William H....Oxenden
Hensman, H. D....Duston Lodge, Northampton
Huntley, Marquis of...Orton Hall, Peterborough
Hutchinson, Col. the Hon. H. K....Weston House Towcester
Isham, Sir E. C. Bart....Lamport Hall, Northampton
Isham, Rev. Robt....Lamport Rectory, Northampton
Jeyes, Francis C....Brixworth
†King, George.. East Haddon, Northampton
Langham, Herbert...Cotteshrooke, Northampton

†Lenton, William, jun....Oundle
Longland, James...Grendon, Northampton
†Lynes, G. B....Hackleton House, Northampton
Lyveden, Lord...Farming Woods, Thrapstone
Manning, John...Orlingbury, Wellingborough
†Markham, Charles, jun....Northampton
Mawer, E....Wyrdelands, Thorney, Peterborough
†Miller, Bartlett...Moulton, Northampton
†Monckton, E. H. C....Fineshade Abbey
Montgomery, Rev. R....Milton, Northampton
†Nethercote, H. O...Moulton Grange, Northampton
Nisbet, R. P....Thorney, Peterborough
Oldham, T. E....Loddington Hall, Kettering
†Oliver, John...Oxenden, Northampton
Oliver, Robert E... Sholbrooke Lodge, Towcester
Ormond, Francis...Moulton Park, Northampton
†Osborn, George...Pattishall, Towcester
†Pell, A., M.P....Hazlebeach, Northampton
†Perceval, Charles...West Haddon
Perkins, W....Singlesole, Thorney, Peterborough
†Phipps, P....Collingtree Grange, Northampton
Potterton, W. H....Boughton Grange, Northampton
Pentelow, John...Rounds, Thrapston
Rooke, John...Weldon Grange, Wansford
Rowell, William...Peterborough
Sartoris, Frederick..Rushden Hall, Higham Ferrers
Scriven, G. W...Castle Ashby, Northampton
Searson, Samuel...Peterborough
Simpkin, B....Fotheringay, Oundle
Singleton, E....Preston Deanery, Northampton
Smith, William...Kettering
Smyth, William...Little Houghton, Northampton
Spencer, Earl, K.G....Althorpe, Northampton
Stopford, W. Bruce...Drayton House, Thrapston
Storer, Rev. J....Hellidon, Daventry
Stratton, J. Locke...Turveston House, Brackley
†Tibbits, Captain...Barton Seagrave, Kettering
†Tryon, Thomas...Bulwick, Wansford
Turner, George, jun....Thorpelands, Northampton
Turner, Jabez...Haddon Grange, Peterborough
Vernon, Hon. F. H....Laundemer House, Oundle
Wallis, Samuel...Barton Seagrave, Kettering
†Wartnaby, John R....Clipston
Waters, Richard...Charwelton House, Daventry
†Wells, William, M.P....Holmewood, Peterborough
†Westmoreland, Earl of...Apthorpe, Wandsford
Wetton, George N....Collingtree, Northampton
†Whitting, William...Thorney, Peterborough
Whitworth, H. B....Northampton
Wilkinson, J. Rennie...Great Addington, Thrapstone
Willows, J. G....Rushton, Kettering
Willson, Thomas...Biggin Grange, Oundle
Wilson, John...2, Albion Place, Northampton
†Wood, Rowland...Clapton, Thrapston
Youmans, Richard...Badby, Daventry
Young, A. A....Orlingbury House, Wellingborough

NORTHUMBERLAND.

Governors.

†Browne, Alex. Henry...Bank House, Acklington
†Grey, Earl...Hawick House, Alnwick
Ridley, Sir M. White, Bart....Blagdon, Cramlington

Members.

†Anderson, Robert...Grey Street, Newcastle
Angus, George...Benwell Grange, Newcastle
Angus, John...Whitefield, Morpeth
Arkle, Thomas...Highlaws, Morpeth
Armstrong, John A....Bay's Leap, Wylam
Armstrong, T. J....5, Hawthorn Terrace, Newcastle
†Atkinson, J. H. H....Angerton, Morpeth
Bainbridge, E. M....Dissington Hall, Newcastle
Balleny, C. D....Red Barns, Newcastle
†Beaumont, W. B., M.P....Bywell Hall, Newcastle
Bell, Robert...Newcastle
Bell, William...Cramlington
†Benson, William...Allerwash House, Hexham
Blackett, Sir E., Bart....Matfen, Newcastle
Blandford, Thomas...Corbridge
†Bolam, Robert G....Weetwood Hall, Wooler
Bolam, W. T....Jesmond Gardens, Newcastle
Bosanquet, Rev. R. W....Roch, Alnwick
Bunning, T. W....34, Grey Street, Newcastle
Burdon, George...Heddon House, Newcastle
Cadogan, Mrs....Brinkburn Priory, Morpeth
Cecil, Lord A....Woodhouse Manor, Morpeth
Cecil, Lord L....Woodhouse Manor, Morpeth
Charlton, W. H....Hesleyside, Hexham
†Chrisp, John...Bank House, Acklington
Clayton, John...Newcastle
†Clutterbuck, T....Warkworth, Acklington
Cockburn, G....Summerhill Grove, Newcastle
Cresswell, A. J. Baker...Cresswell, Morpeth
Culley, George...Fowberry Tower, Belford
†Cuthbert, William...Beaufront, Hexham
Davie, J. Thornton...Hepscott Red House, Morpeth
†Dees, Richardson...Wallsend, Newcastle
Dickinson, G. T....Wheelbirks, Stocksfield
†Dinning, John....Adderstone, Belford
Dinning, J....Langley Hill Top, Haydon Bridge
†Dixon, John Thomas...Walwick Grange, Hexham
Dods, T. P....Anick Grange, Hexham
Donkin, Samuel...Bywell, Felton
Dryden, Thomas...Moss Kennels, Haydon Bridge
Embleton, Robert...Backworth, Newcastle
†Errington, Rowland...Sandon, Hexham
Fawcus, John...South Charlton, Chathill
Fenwick, G. A....The Bank, Newcastle
Fenwick, John C....Newcastle
Gibson, Robert...South Benwell Farm, Newcastle
Goddard, H. R....Belsay, Newcastle
Gray, Thomas...Clayton Street West, Newcastle
†Grey, Charles Grey...Dilston, Corbridge
†Grey, Rt. Hon. Sir G. Bt., M.P...Fallowdon, Alnwick
Hamond, Charles F....Newcastle
†Harle, John Joseph...Mill Hills, Haydon Bridge
Harrett, Robert...Kirkwhelpington, Newcastle
Hawthorn, William...Benwell Cottage, Newcastle
Hedley, Thomas...Cox Lodge, Newcastle
Henderson, William...Fowberry Mains, Belford
Hodgson, Richard...Crofton Mills, Blyth
Hogg, James...Buckton, Belford
Hogg, William...Mitford Steads, Morpeth
Hudspith, William...Brookside, Haltwhistle
Huggup, James...West Sleekburn, Bedlington
James, Thomas...Otterburn Castle, Newcastle

Jobson, William...Buteland, Hexham
Joicey, Edward...Newcastle
Joicey, John...Newton Hall, Stocksfield
King, R. H....Warkworth, Acklington
Langdale, Sampson...Espley House, Morpeth
Lawson, E....Redesdale Cottage, Newcastle
Lawson, Rev. E....Longhurst Hall, Morpeth
Laycock, Joseph...Seghill House
Lee, J. Bunting...Stocksfield Hall
Lee, Joseph...Dilston, Corbridge
Leighton, Robert...Thistleyhaugh, Morpeth
Lennox, William...Six Mile Bridge, Newcastle
Loraine, Edward...The Riding, Riding Mill Station
Marshall, J....Low Horton, Cramlington
Matthews, John, M.D....Tynemouth
Nicholson, George...Winlaton, Blaydon-on-Tyne
†Northumberland, Duke of...Alnwick Castle
Ord, Rev. J. A. Blackett...Whitfield Hall, Haydon Bridge
Orde, Charles W....Nunnykirk, Morpeth
Ormston, Robert...Newcastle
†Oswell, W. B....Eardiston House, West Felton
Palmer, C. Mark...Newcastle-on-Tyne
Ramsay, G. H....Derwent Villa, Newcastle
Rea, Charles...Doddington, Wooler
†Richardson, E....2, Lovaine Place, Newcastle
†Riddell, H. B....Rothbury, Morpeth
Riddell, John...St. Ninians, Wooler
†Riddell, Sir W. B., Bart...Hepple, Rothbury, Morpeth
Ridley, John M....Walwick Hall, Hexham
†Ridley, M. White, M.P....Blagdon, Cramlington
Ridley, Thomas...Parkend, Hexham
Robinson, John...Gosforth, Newcastle
†Robson, John...Byness, Rochester
Row, Edward T....Moulds Haugh
Sanderson, R. Burdon...North Jesmond, Newcastle
Scott, Joseph...Jesmond Road, Newcastle
Smedley, Charles E. B....Shottle House, Belper
†Snowball, F. J....Seaton Burn House, Cramlington
Spencer, John...Whorlton Hall, Newcastle
†Spencer, J. Watson...Whorlton Hall, Newcastle
†Spencer, Michael...Lemington Hall, Blaydon
†Spencer, Thomas...Ryton, Newcastle
Spraggon, Benjamin...Nafferton, Stocksfield
†Stephenson, Clement...Newcastle
Stephenson, Hugh...Dene House, Newcastle
Straker, Henry...Riding Mill
†Surtees, Villiers C. V....Newcastle
Swan, Joseph...3, Carlton Place, Newcastle
Swan, Mark...Lesbury, Bilton
Swan, W. Robert...Wallsend, Newcastle
Swann, John...Bedlington, Morpeth
Swann, William...Bedlington, Morpeth
†Swinburne, Sir John, Bt....Capheaton, Newcastle
†Tate, John...Barnhill, Acklington
Thew, Edward...Lesbury House, Alnwick
Thompson, Alexander...Kirknewton, Wooler
Thomson, W. C....Dilston Haugh, Corbridge
Trevelyan, Sir W. C., Bart....Wallington, Newcastle
Trotter, Thomas...Bywell, Stocksfield
Trotter, William...South Acomb, Stocksfield
Turnbull, George...Tughall House, Chathill
†Waddilove, G. M. D....Brunton House, Hexham
†Wallis, Owen...Bradley Hall, Blaydon
Wallis, Robert...Stocksfield
Watson, John E....Newcastle
Wigham, George...Laverick Hall, Cramlington
Wilson, Jacob...Woodhorn Manor House, Morpeth
†Wilson, Thomas...Shotley Hall, Newcastle
Woods, J. A....Benton Hall, Newcastle
†Wright, T. Irwin...Seaton Burn House, Dudley

NOTTINGHAMSHIRE.

Governors.

Barrow, W. Hodgson, M.P....Southwell
†Brown, James...Rossington, Bawtry
Milward, Richard...Thurgarton Priory, Southwell
†Sutton, John Manners...Kelham, Newark

Members.

Adams, James...The Fallowes, Oxton, Southwell
Allcock, Charles...Bulwell, Nottingham
Allcock, Thomas...Radcliffe-on-Trent
Baily, John, jun....Python Hill, Mansfield
Baker, Robert...Gamston, East Retford
†Barrow, John James...Normanton Hall, Southwell
Bayley, Thomas...Lenton, Nottingham
†Beaumont, G., jun....Bridgford Hill, Nottingham
Beecroft, C....Lowdham Lodge Farm, Nottingham
Beevor, Henry...Blyth, Worksop
Bingley, Charles...Langeld Farm, Worksop
Booth, John...Cotham, Newark
Brett, John...Oxton Grange, Southwell
Brodhurst, Lucas...Upton, Southwell
Burnell, E. P....Winkburne Hall, Southwell
Burrows, T. Ashe...Normanton-on-Trent, Newark
Butler, Richard...Radcliffe-on-Trent
Cane, Rev. T. C....Brackenhurst, Southwell
Carding, F....Combs Farm, Farnsfield, Southwell
†Cartwright, T. W...Ragnall Hall, Newton, Newark
Chadburn, Frank...Cockcliffe Hall, Arnold
Cheetham, Henry...Woodthorpe, Nottingham
Collingham, Joseph...Welham, Retford
Cox, W. S....Sansom Wood, Calverton, Nottingham
†Crawhall, George...West Bank, Mansfield
Cripwell, John...Carlton, Nottingham
Crosland, Jabez...Clumber Street, Nottingham
Davies, Mrs....Rochlaveston Manor, Nottingham
†Dickons, Thomas...High Oakham, Mansfield
Dufty, Thomas...Knapthorpe, Newark
†Edge, James Thomas...Strelley Hall, Nottingham
Esam, William...Averham Park, Southwell
Faulconbridge, W. F....Bestwood Park, Bulwell
Field, Samuel...Farnsfield, Southwell
†Foljambe, F. J. S., M.P...Osberton House, Workso
†Galway, Viscount, M.P....Serlby Hall, Bawtry
Gelsthorpe, Thomas...Morton Manor, Newark
Gilbert, Henry...Barnby Manor, Newark
†Greenfield, George...Belle Eau Park, Ollerton
Hall, Francis...Park Hall, Mansfield
†Hall, Marriott...Thorpe Salvin, Worksop
Hallam, Thomas...Bridlesmith Gate, Nottingham
†Hammersley, W....Parkinson Street, Nottingham
†Hassall, G....Shelford Manor, Radcliffe-on-Trent

†Hemsley, John...Shelton, Newark
Heslop, Rev. Gordon...Cossall, Nottingham
†Hildyard, T. B. T., M.P....Flintham, Newark
Hodgkinson, Enoch...Morton Grange, Retford
†Hodgkinson, Frank...Kirkby Hardwick, Sutton-in-Ashfield
†Hodgkinson, G....Kirkby-in-Ashfield, Nottingham
Hodgkinson, Grosvenor, M.P...Newark
Hole, James...Muskham Woodhouse, Newark
Horncastle, Henry...Edwinstowe, Ollerton
Houghton, Thomas...Hemshill Manor, Nottingham
†Huntsman, Benjamin...West Retford
†Huskinson, Thomas...Epperstone, Southwell
†Johnson, George...Blaco Hill, Retford
Johnson, Joseph...Sutton, Newark
Kelham, Robert...Bleasby Hall, Southwell
Kenrick, George...Thurgarton Hill, Southwell
Knight, W. E....14, Carter Gate, Newark
Lindley, Urban...Radmanthwaite House, Mansfield
Lowe, Robert H....15, Clarendon Street, Nottingham
†Machin, J. Vessey...Gateford Hall, Worksop
Martin, H. B....Colston Bassett, Bingham
Moore, Henry...Bilborough
Moore, John...Calverton
†Musters, John C....Annesley Park, Linby
†Nall, Joseph...Papplewick, Nottingham
Neale, Charles...Newfield, Screveton, Bingham
Neale, Charles J....Mansfield
†Nevile, Rev. C....Thorney, Newark
†Nevile, George...Shebton, Newark
New, David...Waverley House, Nottingham
Nicholson, W. N....Newark-on-Trent
Paddison, Charles F....Stableford, Newark
Paget, Charles...Ruddington Grange, Nottingham
Painter, John...Forest Road, Nottingham
Parke, William...Stragglethorpe, Newark
Parker, T. Sumner...Oxton, Southwell
Parkin, John...Goldthorpe, Worksop
Parkinson, L. Milward...Epperstone, Southwell
†Parkinson, Thomas...Hexgreave Park, Southwell
†Parkyns, Sir T. G. A., Bart....Ruddington
†Parr, John...Cropwell Butler, Bingham
Parr, Samuel...The Park, Nottingham
†Parr, W. F....Cropwell Butler, Bingham
Paulson, F. W....Broomhill Grange, Ollerton
Pott, John Manger...Nottingham
Potts, Bainbriggs...Calverton
Pyatt, Abraham...Wilford, Nottingham
Quibell, W. Oliver...Newark-on-Trent
Reek, Edward...Nuttall, Nottingham
Sanday, George Henry...Holmepierrepont
†Sanday, William...Radcliffe-on-Trent
Scott, Lawrence...Moor End, Ruddington
Shepperson, Thomas...Lenton
Sherbrooke, Henry P....Oxton, Southwell
Simpson, H. Bridgman...Babworth, Retford
Simpson, John T....Boughton, Ollerton
†Smith, Edwards...Radcliffe-on-Trent
†Smith, Henry...Cropwell Butler, Bingham
Smith, Henry A....Wilford, Nottingham
Stafford, Thomas...Marnham, Newark
Storer, Chas., M.D....Lowdham Grange, Nottingham
Tennant, James...Abbey Field Farm, Newstead
Tinley, Edward...Southwell
Toder, E....South Muskham, Newark
Turner, Robert...Bishopfield, Bawtry
†Vere, John...Carlton, Newark
Vernon, Granville H....Grove Hall, East Retford
Walker, Sir E. S....Berry Hill, Mansfield
Walker, John Deverell...Nottingham
Walker, William...Beeston, Nottingham
†Ward, W. Squire...Wellow Hall, Ollerton
Watson, Robert...Scarrington, Whatton
Webb, W. F....Newstead Abbey, Mansfield
Whitaker, Joseph, Jun..Ramsdale Ho., Nottingham
White, Samuel...South Leverton, Retford
†Wigram, John...South Collingham, Newark
†Williams, Ashley G....Sparken, Worksop
Wilson, William...Bulcote, Nottingham
Wood, J. P....Clumber Street, Nottingham
Woolley, T. Smith...South Collingham, Newark
†Wright, H. Banks...Sheldon Hall, Newark
†Wright, William...Wollaton, Nottingham
Wright, William...Fiskerton, Newark

OXFORDSHIRE.

Governors.

Camoys, Lord...Stonor Park, Henley-on-Thames
Marlborough, Duke of, K.G....Blenheim Park

Members.

Allnutt, T. Alexander..Watlington Farm, Tetsworth
Ashhurst, John H....Waterstock, Oxford
Bacchus, William E....Horley, Banbury
Badcock, Benjamin...Headington Hill, Oxford
Baker, J. W....Little Rolbright, Chipping Norton
Baker, Rev. R. L....Ramsden, Enstone
Baker, William...Coombe Farm, Woodstock
Barnett, Henry, M.P....Glympton Park, Woodstock
†Bateman, Henry...Asthall, Witney
†Bayley, Rev. W. R. ...Cassington Vicarage, Oxford
Beaumont, Joseph...Ducklington, Witney
Berridge, Thomas..Pimlico Farm, Tusmore, Bicester
Blagrave, Edward...Oxford
Blake, Alfred...Sutton, Stanton Harcourt, Witney
†Bowyer, Captain H. A....Steeple Aston, Woodstock
Brickwell, C. J....Overthorpe Lodge, Banbury
†Brown, A. H. C....Kingston House, Tetsworth
Browne, Rev. T. C....42, St. Giles's, Oxford
Browning, James T....Oxford
Bryan, John...Southleigh, Witney
†Bulford, James...Hordley Farm, Woodstock
†Caless, William...Bodicote House, Banbury
Cannon, Joseph C....Beckley, Oxford
Cartwright, Richard Aubrey...Edgcott, Banbury
Castle, George...Sutton, Stanton Harcourt, Eynsham
Castle, George R....Bicester
Chamberlin, William...Adderbury, Banbury
†Chillingworth, John...Horsepath, Oxford
†Churchill, Lord...Wychwood Park
Clarke, E. C....Haddenham, Thame
†Clarke, G. R....Chesterton Lodge, Bicester
†Clinch, Charles...Witney
†Cole, William Douglas...Bicester

Combe, Thomas...Oxford
Cooper, Henry Reeve...Britwell, Watlington
Craddock, R....Lyneham, Chipping Norton
Crundwell, G....Rose Mount, Iffley, Oxford
†Dashwood, Captain F. Loftus...Kirtlington Park
Dashwood, Sir Henry W., Bart....Kirtlington
†Davenport, F. H....Headington Hill, Oxford
†Davis, R. S. B....Swerford Park, Enstone
†Davis, Samuel...Swerford Park, Enstone
†Dickens, Samuel S....Golder Manor, Tetsworth
Dodwell, J....Manor House, Long Crendon, Thame
Dormer, C. Cottrill...Rousham, Woodstock
†Druce, A. F. Milton...Twelve Acres, Eynsham
†Druce, Joseph...Eynsham
†Druce, Samuel...Eynsham
Early, Thomas...Witney
Effingham, Earl of...Tusmore House, Bicester
†Franklin, Joseph...Little Haseley, Tetsworth
Freeman, Edwin...Chilton, Thame
Freer, F. Hubert...Oddington, Chipping Norton
†Gammie, George...Shotover House, Wheatley
Garne, George...Churchill Heath, Chipping Norton
†Gaskell, Henry L....Kiddington Hall, Woodstock
†Gayner, C., M.A....1, New College Lane, Oxford
Gillett, Frederick...Upton Downs, Burford
Gillett, John...Oaklands, Charlbury
Gillett, John...Minster Lovell, Witney
Glen, George...Stratton Audley Park, Bicester
Godson, Nicholls S....Little Tew, Enstone
Godwin, Mrs....Troy Farm, Deddington
Greaves, John...Elsfield, Oxford
Griffin, J. Whitehouse...Towersey Manor, Thame
Gulliver, William...Swalcliffe, Banbury
Gutteridge, Charles...Assendon, Henley-on-Thames
Hall, Richard...Great Barford, Deddington
Hamersley, Hugh...Great Haseley, Tetsworth
†Harcourt, E. W....Nuneham Park, Oxford
Hatton, William...Kingston, Tetsworth
†Hawkes, William...Thenford, Banbury
Henley, Joseph J....Shotover Lodge, Oxford
†Henley, Rt.Hon. J.W., M.P...Waterpury,Wheatley
†Hester, George P....Oxford
Hewer, Robert...Fair Green Farm, Chipping Norton
†Holbech, Rev. C. W....Farnborough, Banbury
Hopkins, Rev. T. H. T....Magdalen College, Oxford
Howland, A. R....Ludesden House, Thame
Hughes, James...Wood Lawn, Oxford
Hutt, John...Water Eaton, Oxford
†Keene, Rev. C. Ruck..Swincombe House, Nettlebed
King, Frederick...West Lawn, Kirtlington
King, W. Padbury...Lower Heyford, Banbury
Knollys, Gen. Sir W., K.C.B...Blount's Court, Henley
Lord, Richard...Stanton Harcourt, Witney
†Macclesfield, Earl of...Sherburn Castle, Tetsworth
†Mackenzie, E....Fawley Court, Henley-on-Thames
Marriott, Captain E. J....Burford
Marsham, R., D.C.L....Merton College, Oxford
†Mason, James...Eynsham Hall, Witney
†Mather, D....Chadlington, Enstone
Mewburn, W....Wykham Park, Banbury
†Middleton, Henry...Cutteslow, Oxford
Millington, Mrs....Ashgrove, Ardley, Bicester
†Morrell, F. J....St. Giles's, Oxford
Mumford, J. A....Chilton Park Farm, Thame
Nalder, J.Hall...Haseley, Tetsworth
Nevell, Edward...Chawley Farm, Cumnor, Oxford
†Newton, R. J....Campsfield, Woodstock
†Newton, William...Gould's Grove, Benson
†Norreys, Viscount...Wytham Park, Oxford
North, Lieut. Colonel, M.P..Wroxton Abbey, Banbury
†Parsons, Herbert...Elsfield, Oxford
†Parsons, John...Iffley, Oxford
Parsons, W....Hill Farm, Elsfield, Oxford
Parrott, Edward...Shirburn, Tetsworth
Parker, James S....Iffley, Oxford
†Paxton, Edmund...Willaston House, Bicester
Paxton, Jonas...Bicester
†Perry, T. A...Betham House, Avon Dassett, Banbury
Pickering, Leonard...Wilcote, Charlbury
†Piercy, Alfred...Coldharbour, Henley
Pinnell, Charles...Westwell, Burford
Reade, J....Shipton, Chipping Norton
Reynardson, H. B....Adwell, Tetsworth
Robbins, Harry...Northfield Farm, Witney
Roberts, Joseph...Caswell House, Witney
Rowland, John...Holly Bank, Wootton, Woodstock
Rusher, William...High Street, Banbury
Samman, William...Middleton Park, Bicester
Samuelson, Bernhard, M.P....Banbury
Savidge, Matthew...Sarsden, Chipping Norton
†Sheldon, Jonathan...Eynsham
Sheldon, Jonathan, jun....Eynsham
Sheldon, Thomas...Osney Mill, Oxford
†Shillingford, George W....Eynsham
Smith, Samuel...Somerton, Deddington
Stilgoe, Nathaniel...Adderbury, Banbury
†Stilgoe, Z. W....Adderbury Grounds, Banbury
Symonds, Horatio P....Oxford
Tawney, A. R....Banbury
Taylor, Thomas...Ashton Rowant, Tetsworth
Thomson, Guy...Old Bank, Oxford
†Thomson, John...Baldon House, Oxford
Tredwell, William...Elsfield, Oxford
Vanderstegen, W. H....Cane End House, Henley
Ward, William...41, St. Giles's, Oxford
Watson, John...Shirburn Castle, Tetsworth
†Weaving, John W....Oxford
Wiggins, Walter John...Watlington
Wiggins, William...Watcombe Farm, Watlington
Wilkinson, William...Oxford
†Worley, William...Stanton Harcourt, Eynsham

RUTLANDSHIRE.

Governor.

Gainsborough, Earl of...Exton Hall, Oakham

Members.

Addison, J....Brookfield Gretton, Uppingham
Aveland, Lord...Normanton Park, Oakham
†Barnes, Wilson...Teigh, Oakham
Bosworth, J. G....Greetham, Oakham
Cutting, Robert Coote...Ridlington, Uppingham
†Duncan, Alexander...Knossington Grange, Oakham
†Eyre, Edwin...Preston Hall, Uppingham
Finch, George H., M.P....Burley-on-the-Hill, Oakham

†Gilford William...North Luffenham, Uppingham
Painter, Benjamin...Burley-on-the-Hill, Oakham
Ward, Robert...Harringworth, Uppingham
†Wing, William...Market Overton, Oakham
Winn, Mrs....Uppingham
Wortley, Edward...Ridlington, Uppingham

SHROPSHIRE.

Governors.

Cotes, John...Woodcote, Newport
†Hill, Viscount...Hawkstone Park, Shrewsbury

Members.

Archer, James...Combermere Abbey, Whitchurch
Ashdown, A. H....Uppington, Wellington
Ashdown, S. Harding...Uppington, Wellington
Asterley, W. L....Pentref, Llanymynech, Oswestry
Austin, Harry C....Allscott, Wellington
Backhouse, R. O....Westwood, Bridgnorth
Barber, Richard...Harlescott, Shrewsbury
Bate, John William...Astol, Shifnal
Bate, Richard Stokes...Badger, Shifnal
Bateman, J....Croxton Hanmer, Whitchurch
†Bather, Thomas...Maesbury Hall Mill, Oswestry
Bayley, John...Tilstock, Whitchurch
Beck, Francis Henry...Albrighton, Shifnal
Beck, Peter...Shrewsbury
Beckett, Joseph...Belvedere, Whitchurch
†Beckwith, Rev. H....Eaton Constantine, Wellington
Beeston, Thomas..Goldstone Manor, Market Drayton
†Benson, George...Lutwyche Hall, Wenlock
Bibby, J. J....Hardwicke Grange, Shrewsbury
Bickerton, S....Shotatton, Ruyton Eleven Towns
Bigge, C. Selby..Bourton Grange, Much Wenlock
Blantern, George G....Haston, Hadnall, Shrewsbury
Bolden, Samuel E..The Council House, Shrewsbury
Booker, Joseph...Wilbrighton Hall, Newport
†Borough, C. B....Chetwynd Park, Newport
Botfield, Rev. W. B. Garnett...Decker Hill, Shifnal
Boulton, John...Bowling Green Farm, Shifnal
Boulton, W. Baker...The Liziard, Shifnal
Bourne, S....Goldsmith House, Whitchurch
Bowen, Edward H....Kingslow, Bridgnorth
Bowen, Humphrey C....Chesterton, Bridgnorth
Bowen, John, jun....Dunvall House, Bridgnorth
Bowen, Thomas...Wootton, Bridgnorth
Bradford, Earl of...Weston Hall, Shifnal
Brewster, W....Balderton Hall, Middle, Shrewsbury
Bridgeman, John...Ascott Hall, Shrewsbury
Bright, John...Styche, Market Drayton
Brooke, Rev. John...Haughton, Shifnal
†Broughton, P....Tunstall Hall, Market Drayton
Brown, Henry...Preston, Wellington
Brown, Richard...Ruyton Eleven Towns
Browne, Samuel...Brocton Hall, Shifnal
Burd, Thomas A....Burcot, Wellington
Burton, R. H. Lingen...Chilton Grove, Shrewsbury
†Charlton, St. John C....Apley Castle, Wellington
Chetwode, Sir J. N. L., Bt..Oakley, Market Drayton
Clay, Charles...Whitchurch
Clay, John...Kinsale, Whittington, Oswestry
Clews, R. T....The Woodlands, Weston, Shifnal
†Cocks, Rev. C. R. Somers...Nene Savage Rectory, Cleobury Mortimer
Cocks, John...Dinchope, Wistanstow
†Corbet, H. R....Adderley Hall, Market Drayton
Corbett, Henry...Hilgford, Shifnal
Corbett, Thomas...Shrewsbury
†Corbett, Captain R. J....Bridgnorth
Corden, Arthur H....Brineton, Shifnal
Corden, John...Great Chatwell, Newport
Cottle, George...West Felton, Shrewsbury
†Cotton, Hon. R. W. S...Bourlton Park, Shrewsbury
Crane, Edward...Forton, Montford, Shrewsbury
Crane, Joseph...Calcot, Shrewsbury
Crowley, John L....Standford Hall, Newport
Cureton, George...Beam House, Shrewsbury
†Curtis, Sir W., Bart....Caynham Court, Ludlow
Cust, Captain F. H....Ellesmere
Danford, William Lewis...Langley, Bromfield
†Darby, Alfred...Stanley Hall, Bridgnorth
Davies, James...Isle Park, Shrewsbury
Davies, William...Mardre, Llandrinio, Oswestry
Davis, Evan H....Patton, Much Wenlock
Davis, T....Little Wenlock, Wellington
Day, John...High Street, Whitchurch
Dickin, E. T....Yockings Gate, Whitchurch
Dickin, William...The Lloyd, Market Drayton
Downward, Rev. G. R....Shrewsbury
Dunn, John...Fernhill Villa, Market Drayton
†Dyer, Major H. C. S....Westhorpe, Bromfield
†Eddowes, Thomas Henry...Pontesbury
Edwards, Edward...Boreton, Shrewsbury
Edwards, Edwin...Brocton Grange, Shifnal
Edwards, G. Withers, jun....Woolston, Oswestry
Edwards, Richard...Adlington, Shrewsbury
Elwell, Charles...Evelith Manor, Shifnal
Elwell, Paul...Evelith Manor, Shifnal
Emery, Richard A....Lostford, Market Drayton
Evans, John...Uffington
Evans, John...Hadnall Wood, Hadnall
Eyke, John...Stanton, Shifnal
†Eyton, Thomas C....Vineyard, Wellington
†Fenn, Thomas...Stonebrook House, Ludlow
Forester, G. T....Ercall Magna, Wellington
†Foster, W. O....Apley Park, Bridgnorth
Foulkes, C....St. Mary's Street, Whitchurch
Fowler, William...Acton Reynold, Shrewsbury
Fox, John...Coalbrookdale, Wellington
†France, James...Grinshill, Shrewsbury
Frank, John Charles...Rhydairy, Oswestry
†Fryer, H. C....Lodge Park, Taliesin, Shrewsbury
†Gatacre, E. Lloyd...Gatacre Hall, Bridgnorth
†Godsall, Philip W....Iscoyd Park, Whitchurch
Goodall, W. H....Sutton, Market Drayton
Gouldbourne, J....Wilksley, Burleydam, Whitchurch
Gower, Andrew...Market Drayton
†Granville, Earl, K.G....Aldenham, Bridgnorth
†Green, Joseph B....Marlow, Leintwardine
Griffithes, Thomas J....Bishops Castle
Griffiths, John...Honlston, Middle
†Groom, James...Arlston House, Wellington
Groves, Robert, V.C....Berrington, Shrewsbury
Hanmer, Sir J., Bart., M.P...Bettisfield, Whitchurch

Harding, E. W....Old Springs, Market Drayton
Harding, John...Bicton House, Shrewsbury
Harries, Francis...Cuckton Hall, Shrewsbury
Harris, Thomas...Moston, Stanton
Hassall, William...Bubuey, Whitchurch
Heath, John...Cleobury Mortimer
Heatley, John..Broughton, Harmer Hill, Shrewsbury
Heatley, John...Eaton, Market Drayton
†Heatley, R. T....Eaton Grange, Market Drayton
†Herbert, Major-Gen., the Right Hon. Sir P. E., Bart., M.P....Styche, Market Drayton
Higgs, Albert A....Little Wenlock, Wellington
Hill, Rev. John...Hawkstone, Shrewsbury
Hill, Richard...Orleton Court, Ludlow
Hinckesman, Charles H....The Poles, Ludlow
Hollis, Edward...West Felton
Hoole, Arthur...Hinnington House, Shifnal
Hornby, Captain R.M. ...Hanley House, Shrewsbury
†Hornby, Rev. R....Boyston Hill, Shrewsbury
Horton, George...Harley, Much Wenlock
†Horton, S. Lewis...Park House, Shifnal
Horton, Thomas...Harnage Grange, Shrewsbury
Hudson, C. D...Cheswardine, Market Drayton
Hudson, John...Sibberscott, Lea Cross
†Hudson, Samuel...Wytheford Hall, Shawbury
Hudson, Thomas...Longford Farm, Market Drayton
Humphreys, W. T....Calcott Hall, Oswestry
†Hunter, L. R....Bedstow House, Aston-on-Clun
†Hunter, Patrick...Roden, Wellington
Ikin, Edward...Moat House, Wem
†Ingram, George...Chetwynd Park, Newport
Jenkin, H. B....Cotton Farm, Whitchurch
Jones, F....The Old Hall, Hanmer, Whitchurch
†Jones, J. Bowen...Esndon Hall, Baschurch
Jones, James...Norville, Bridgnorth
Jones, John...The Lodge, Whitchurch
Jones, Stephen...Lea Cross
Jones, Thomas...English Frankton, Ellesmere
Jones, Rev. William...Baschurch, Shrewsbury
†Jones, William...Harrington, Shifnal
Juckes, George...Beslow Hall, Wroxeter
Juckes, Mrs....Cotwall, Wellington
Juckes, Thomas...Tern, Wellington
†Justice, Henry...Hinstock, Market Drayton
Keary, H. W....Aldenham, Bridgnorth
Kelsall, George...Marton, Baschurch
Kelsall, Thomas...Bettisfield Hall, Whitchurch
Kempster, William...New Cricket, Ellesmere
†Kenyon, Hon. E....Macefen, Whitchnrch
†Knight, A. J. R. Boughton...Downton Castle, Leintwardine
Langford, William...Cherbnry Hall
Lea, James...Dodecote Grange, Market Drayton
Lee, J. H....Redbrook, Whitchurch
Lee, Thomas S....Brincton House, Shifnal
Leeke, Ralph L....Longford Hall, Newport
Leigh, William...Wilksley, Whitchurch
†Leighton, Stanley...Sweeny Hall, Oswestry
Lewis, William...Shrewsbury
Lightfoot, F. L....Market Drayton
†Lloyd, Arthur P....Shawbury, Shrewsbnry
Lloyd, J. A....Leaton Knolls, Shrewsbury
†Lloyd, Richard T....Aston Hall, Oswestry
Lloyd, W. B....Preston Montford Hall, Shrewsbury
†Lowndes, W. L....Linley Hall, Bridgnorth
†Mainwaring, Salusbury K....Oteley, Shrewsbury
Mansell, Andrew...Little Ness, Baschurch
†Mansell, Thomas...Ercall Park, Wellington
†Mansell, Thomas J....Adcott Hall, Baschurch
Matthews, Henry...Montford, Shrewsbury
Meire, T. L....Eyton-on-Severn, Shrewsbury
Minor, John...The Grove, Kingsland, Shrewsbury
†Minton, John...Forton, Shrewsbury
Minton, T. S....Forton, Montford, Shrewsbury
Moody, Geueral...Caynbam House, Ludlow
More, R. Jasper...Linley Hall, Bishop's Castle
Morris, James...Union Place, Oswestry
Mort, William...Marton, Baschurch
Nevett, William...Yorton, Harmer Hill, Shrewsbury
Newill, Joseph...Lydbury North
†Newport, H. A. W....Coton Hall, Bridgnorth
†Newport, Viscount, M.P....Weston, Shifnal
Niccolls, W. H....Newnham, Shrewsbury
Nickolls, James...Tuck Hill, Bridgnorth
†Nightingale, Vanghau E....Burway, Ludlow
Nock, Charles...Norton, Shifnal
Nock, Thomas...Sutton Maddock, Shifual
Nock, T. F....Kingslow, Bridgnorth
Norris, W. G....Coalbrookdale, Wellington
Nunnerley, Thomas...Bradley Green, Whitchnrch
†Palin, William...Twyford House, West Felton
Palmer, Robert...Nagiugton, Market Drayton
Parrish, R....Uplands Farm, Bridgnorth
†Parry, Charles...Houghton, Ellesmere
†Payne, William...Willcott, Nesscliff
Peck, Edmund...Plas-y-Ddinas, Shrewsbury
†Pemberton, Rev. R. N...Millickhope Park, Church Stretton
†Perry, Graddon...Acton Pigott, Condover
Phillips, G. T....Brockton Leasowes, Newport
Picken, William...Hilton, Newport
Platt, John...Belle Vue, Wem
†Poole, C. H....Marbury Hall, Whitchurch
Pooler, Henry...The Poplars, Vatley, Wellington
Preece, W. G....Shrewsbury
Price, Andrew...Bagley, Ellesmere
Price, James...St. Miborough, Ludlow
Price, T. S....Felton Butler, Baschurch
†Pritchard, John...Broseley
†Pryse, Sir Pryse, Bart....Gogerddan, Bowskeet
†Pugh, William...Coalport, Ironbridge
Pullen, R....Shackerley House, Albrighton
Purton, C. C....The Woodhouse, Cleobury Mortimer
Radcliffe, Thomas...Cheswell Grange, Newport
Rainforth, Edward...Monkhopton, Bridgnorth
†Ralph, R. W....Honnington Grange, Newport
Ravenshaw, James...Bridleway Gate
†Richards, John...Llyncleys, Oswestry
Rider, Thomas...Edgeboulton, Shawbury
Rider, Thomas John...Kenwick, Shrewsbury
Rider, William...Crudgington, Wellington
Roberts, Benjamin...Belle Vue, Oswestry
Roberts, R....The Rock, Richard's Castle, Ludlow
Roberts, T. Lloyd...Corfton Hall, Bromfield
†Robinson, George...Whiston, Shifnal
†Rouse-Boughton, Sir C. H., Bt..Downton Hall, Ludlow

Sankey, Mrs....Bratton Farm, Wellington
Saunders, G. J....Oswestry
Savage, Gilbert C....Pony Knoll, Shifnal
Saxton, W. Waring, M.D....Market Drayton
Scarth, Jonathan...Shrewsbury
Sheraton, William...Broom House, Ellesmere
Shingler, J. H....Birch Hall, Ellesmere
Simon, Thomas...Fern Hill, Market Drayton
Sing, William...Newton, Bridgnorth
Sladen, Captain J. B....Donnington, Newport
Slaney, John...Purville House, Wellington
Smith, Henry...Eaton Constantine, Wellington
Smith, Henry...Harnage, Shrewsbury
Smith, Henry...Sutton Maddock, Shifnal
Smith, R. Thursfield...Whitchurch
Smith, Thomas...Stableford, Bridgnorth
Smith, William...Little Hales, Newport
Smyth, Sir C. F., Bart....Acton Burnell, Shrewsbury
†Smythies, George...Leintwardine, Shrewsbury
Spence, Charles...Little Holt Farm, Bridgnorth
Stanier, John E....Uppington, Wellington
Stanley, Henry...Upton, Shifnal
Stedman, W....Bucknell House, Bucknell
Steedman, E. B....High Ercall Hall, Wellington
Summer, Richard...Worfield, Bridgnorth
Summers, Thomas, jun....Cowgreaves, Shifnal
Tanner, Richard...Frodesley, Donington
Taylor, Edward...Whitton, Leintwardine
Taylor, William H....High Hatton, Shawbury
Teece, Richard...Weston Villa, Baschurch
Teuch, John...Ludlow
Thomas, Edward...Victoria Parade, Oswestry
Thomas, Richard...The Buildings, Baschurch
Thomas, Thomas...Treprenal, Oswestry
Thompson, T. Warren..Claremont Bank, Shrewsbury
Thornton, Edward...Little Pitchford, Shrewsbury
Thursfield, Thomas H....Barrow, Broseley
Titterton, J. Ward...Shifnal
Topham, Thomas...The Twemlows, Whitchurch
Tudge, William...Adforton, Leintwardine
Underhill, W. S....Newport
Vaughan, W....The Lodge, Ruyton Eleven Towns
Vernon, Benjamin...Aychley, Prees
†Vickers, Valentine...Ellerton Grange, Newport
†Wainman, B....Witley Manor, Newport
Ward, Felix J....The Lea, Cleobury Mortimer
Ward, William...Penyhont Hall, Oswestry
Warter, H. de Grey...Longden Manor, Shrewsbury
Webster, F. T....Bishton Hall, Shifnal
Weston, Philip...Coalbrookdale, Wellington
Whitfield, Edward...Oswestry
Whitfield, G....Chiswardine Park, Market Drayton
†Whitmore, Rev. F. H. Wolryche..Dudmaston Hall, Bridgnorth
Wilde, H. J....Hopstone, Claverley, Bridgnorth
Wilkes, Samuel...Brewers Oak, Shifnal
Williams, Hugh...Chesterton, Bridgnorth
Williams, Matthew...Dryton, Wroxeter
Williams, Thomas...Albrightlee, Shrewsbury
Wilson, John...Aston Hall, Claverley, Bridgnorth
Wingfield, C. G....Onslow Hall, Shrewsbury
Wood, Edward...Culmington Manor, Bromfield
Woodfin, John...Aston, Wem
Worthington, Archibald...Whitchurch
Wright, Edmund...Halston, Oswestry
Wyley, Henry James...Bridgnorth
†Wyley, William...Vineyard, Wellington
†Wyley, W. John...Admaston, Wellington
Wynn, Richard...Cricket, Ellesmere
Yates, Frank G....Ironbridge
Yates, James...Aitchley, Shifnal
Yates, William...Grindle House, Shifnal

SOMERSETSHIRE.

Governors.

Bridport, Lt.Gen.Viscount..Cricket St. Thomas, Chard
Dickinson, Francis Henry..Kings Weston, Somerton
†Miles, Sir William, Bart....Leigh Court, Bristol

Members.

Abraham, Thomas...Dunster, Taunton
Allen, Major Ralph S., M.P...Shockerwick, Bathford
†Aplin, Henry...Coombe St. Nicholas, Chard
†Bailey, James...Burnham, Bridgwater
†Barker, G. I. Raymond...17, Royal Crescent, Bath
†Barton, Charles...Holbrook House, Wincanton
†Batson, Thomas...Bath
†Batten, John...Yeovil
Bell, J. Williams...Gillingham, Bath
Bennett, Thomas Oatley...Bruton
Blake, William...Bridge, Ilminster
Bond, Abraham...Huntstile, Bridgwater
†Braikenridge, J. H....Chew Magna, Bristol
†Bullen, John T....Marshwood Manor, Crewkerne
†Bullock, George...East Coker
†Bult, James S....Dodhill House, Kingston, Taunton
†Capel, Arthur...Bulland Lodge, Wiveliscombe
Chaffey, Ebenezer...Keinton Mandeville, Somerton
†Clarke, T. E....Tremlett House, Wellington
†Clerk, E. H....Burford, Shepton Mallet
Colthurst, John...Chew Court, Chew Magna, Bristol
†Cotterell, Jacob Henry...6, Terrace Walks, Bath
†Cuff, W. Fitchett...Merriott, Taunton
Davis, Henry...Old Downs, Oakhill, Bath
†Dean, A. Keball....East Brent, Axbridge
†Dean, F. Keball...East Brent, Axbridge
†Dickinson, E. H....Berkeley, Frome
†Duckworth, Russell...Murtrey Hill, Frome
Dyke, Thomas...Ashton Lodge, Bristol
Easton, William...6, Hammet Street, Taunton
Eckley, Richard...12, Darlington Place, Bath
Edwards, Joseph...Hutton, Weston-super-Mare
†Evans, W. Herbert...Ford Abbey, Chard
Farthing, Walter...Stowey Court, Bridgwater
†Fitzgerald, Maj. H. T. G...Maperton Ho., Wincanton
Fussell, Rev James G. C....The Chantry, Frome
†Gibbs, George...Belmont, Bristol
Gibbs, William...Tyntesfield, Bourton, Bristol
Goodwin, Josiah...Bath
†Gray, Frederick...Castle Carey
†Gray, Jonathan.... Backwell Hill, Bristol
†Grenville, R. Neville, M.P..Butleigh Ct., Glastonbury
†Halliday, J....Chapel Cleeve, Taunton
Hancock, J. D....Halse, Taunton
Harbin, George, Newton House, Yeovil

Harding, T. King...Maiden Bradley, Bath
†Harford, J. B....Stoke Bishop, Bristol
†Harford, W....Barley Wood, Wrington, Bristol
Helyar, W. H....Coker Hall, Yeovil
†Henley H. C....Leigh House, Chard
Hewett, W. H....Norton Court, Taunton
Hicks, G. H. T....Hill Grove, Wells
†Hippisley, John...Stone Easton, Bath
Hole, James...Knowle, Dunster
†Hood, Sir A. A., Bart....St. Audries, Taunton
†Hoskins, Thomas...Haselbury, Crewkerne
Howard, William...Windsor Terrace, Taunton
Hurle, J. Cook...Brislington, Bristol
King, R. King Meade...Walford, Taunton
†Knatchbull, William...Babington, Frome
Knollys, J. E....Fitzhead Court, Taunton
Lang, T. M....Barrington Court, Ilminster
†Langton, W. H. P. Gore...Newton Park, Bath
†Lee, J. Lee...Dillington House, Ilminster
†Lethbridge, Charles...Easthrook House, Taunton
Logan, John...11, Lansdowne Crescent, Bath
†Lovell, Edwin...Dinder, Wells
†Lovell, E. W. Lovell...Dinder, Wells
Luttrell, Colonel H. A. F....Badgworth Court, Weston-super-Mare
Luttrell, Rev. A. H. F..Minehead Vicarage, Taunton
Male, Henry...East Chinnock, Yeovil
Mallock, Charles H....Cockington, Torquay
Maud, Charles T....Waterhouse, Bath
†Miles, J. W....King's Weston, Bristol
†Miles, P. W. S....61, Queen Square, Bristol
†Moysey, Henry G..Batheaton Court, Wiveliscombe
†Naish, W. B....Stone Easton, Bath
†Napier, E. B....Pennard House, Shepton Mallet
†Newbury, R. P....Webbe House, Chard
Ostler, John...Isle Brewers, Taunton
Paget, Edward...Burnett, Bristol
Paget, Major R. H., M.P....Cranmore Hall, Shepton Mallet
†Parsons, George...Martock
†Parsons, Henry...Haselbury, Crewkerne
†Paull, J. W....Knott Oak House, Ilminster
Penny, Thomas...Taunton
Peren, W. B....Compton, South Petherton
Peters, Daniel...31, College Green, Bristol
Pinney, Col. W...Somerton Erleigh, Taunton
Proctor, T....Elmdale House, Clifton, Bristol
Rayer, W. Carew...Holcombe Court, Wellington
Robinson, John...Backwell House, Bristol
Robinson, W....Wemhdon, Bridgwater
Rose, Christopher...Zeals, Bath
Skrine, H. D....Warley Manor, Bath
Smith, Robert...Chew Magna, Bristol
†Smith, William...Sandon House, Clifton, Bristol
†Somerville, J. C....Dinder House, Wells
†Sparks, William...Crewkerne
†Stanton, Rev. J. J....Lovington Vicarage, Bath
†Stephens, Robert...13, Paragon, Bath
Strangway, H. B....Shapwick, Bath
Stuckey, H....Bishops Lydiard, Taunton
†Surtees, W. E....Tainfield House, Taunton
†Vincent, James...Clifton Mayhank, Yeovil
†Ward, T. J....Fern Park, Olveston, Bristol
Warre, Henry...Langford Budville, Wellington
Warry, George...Shapwick, Glastonbury
Were, Francis...Gratwicke Hall, Barrow Gurney
Wightman, John...Chard
Wollen, Joseph...Wedmore

STAFFORDSHIRE.

Governors.

†Buller, Sir E. M., Bt., M.P..Dilhorne Castle, Cheadle
†Dartmouth, Earl of..Patshall Hall, Wolverhampton
†Sutherland, Duke of, K.G....Trentham Hall

Members.

Abbotts, R. W....Burton-on-Trent
Allen, George...Knightley Hall, Eccleshall
Arnold, William...Lichfield Street, Tamworth
Ashcroft, Thomas...Walford, Eccleshall
Averill, Charles, jun....Pyrchill, Stone
Averill, E....Wood Gate, Kings Bromley, Lichfield
Averill, George Hanson...Wood End, Lichfield
†Avery, William Howard...Tixall Heath, Stafford
Bagnall, George...Draycot, Cheadle
†Bagot, Lord...Blithefield, Rugeley
Bantock, T....Merridale House, Wolverhampton
Barnett, T. J....13, North Street, Wolverhampton
Barns, John...Shenstone, Lichfield
Barratt, C. Underwood...Eccleshall
†Barrow, Wm....Bilbrooke House, Wolverhampton
Barton, J. Pipe...Bangley, Tamworth
Bass, Michael T., M.P....Burton-on-Trent
Bate, Samuel...Springfields, Newcastle-under-Lyme
Beach, J....Standeford Cottage, Wolverhampton
Beach, Mrs....The Hattons, Brewood
Bealey, J. Edward...Bloxwich, Walsall
Bennett, Joseph B. H....Tutbury, Burton-on-Trent
†Bennion, Owen...Cresswell, Stafford
Bickford, Joseph...Oxley, Wolverhampton
Bill, John...Trent Vale, Stoke-on-Trent
Billington, John S....Netherset Hey, Madeley
Birch, James...Pearse Hay, Penkridge
Bloxcidge, John Smith...Mere Pits, Tamworth
Blurton, Edward...Wolverhampton
Blurton, W. Mountfort...Field Hall, Uttoxeter
Bond, Benjamin...Draycot, Cheadle
Bond, Peter...Draycot, Cheadle
Bonehill, C. G....Bickford Grange, Penkridge
Boot, William...Chesterfield, Lichfield
Booth, John...Shenstone Hall, Lichfield
Booth, Thomas...Tamborne Park, Lichfield
Bostock, Edwin...The Haugh, Stafford
Bostock, Thomas ..Hill Top, Burslem
Boucherett, Henry Robert...Hoar Cross, Rugeley
Bourne, John...Hildenstone, Stone
Bradhurn, William...Hilton, Wolverhampton
Bradburne, J. Hanbury...Pipe Place, Lichfield
Brealey, John...Leek
Brewster, John...Stretton Mill, Penkridge
Bridgwood, George...Bedwall, Stafford
Briggs, William...Elford Park, Tamworth
Broomhall, T. T., M.D....Beech Cliff, Newcastle
Brough, William S....Fowlchurch, Leek

Brown, Charles...Park Hall, Leigh, Cheadle
Brown, Michael L....Hagley Hall, Rugeley
Brown, Richard...Walton Bank, Stone
Brown, Robert...Wiggington House, Tamworth
†Buller, Morton Edward...Dilhorne, Cheadle
Burchnall, Samuel...Catton, Burton-on-Trent
Byrd, Charles...Littywood, Stafford
Byrd, Frederick...Dunston, Penkridge
†Calthorpe, Lord...Perry Hall, Stafford
Carrington, William T....Hollington, Uttoxeter
Cartwright, Robert...Wergs, Wolverhampton
Challenor, John..Blackwood, Endon, Stoke-on-Trent
Chawner, Henry...Hound Hill, Uttoxeter
†Chawner, Richard Croft...The Abnalls, Lichfield
Cheatle, T. Farmer...Dosthill, Tamworth
Chetwynde, Major W. F....Brocton Hall, Stafford
†Clarke, Charles F... Purton Grove, Wolverhampton
Cleminson, Robert...Endon, Stoke-on-Trent
Clifft, Samuel...Fordhouse Mill, Wolverhampton
Cocks, Charles...Packington, Lichfield
Collins, William...Aston Farm, Stafford
Colvile, Captain A. H. A....Churnett Grange, Leek
Colvile, C. R....Lullington Hall, Burton-on-Trent
Cope, T. Berwick...Tettenhall, Wolverhampton
Coxon, John...Freeford Farm, Lichfield
†Darling, J....Beau Desert, Rugeley
Dean, James...Brereton, Rugeley
Denton, Henry...Wolverhampton
Deykin, James....Whiston, Penkridge
Dicken, Thomas, jun....Colton Hall, Rugeley
Dickens, R. A....Woodford Grange, Wolverhampton
Douglas, J. Bryant...Lullington, Burton-on-Trent
Dyott, Col., M.P....Freeford Manor, Lichfield
†Elwell, Charles John...Compton, Wolverhampton
†Farmer, C. Haywood...Comberlord Hall, Tamworth
†Farwell, Frederick G....Wolverhampton
Faulkner, John...Brethy Farm, Burton-on-Trent
Fitzherbert, Sir W., Bt..Somersall Herbert, Uttoxeter
Fitzherbert, W....Swynnerton, Stone
†Ford, George...Barlastone, Stone
Ford, W. H....Merridale Road, Wolverhampton
†Forster, Charles, M.P....Lysways Hall, Rugeley
Forsythe, James...Wolverhampton
Fryer, W. Fleming...The Wergs, Wolverhampton
Gardom, John W....Butterton Hall, Newcastle
Gillard, Henry...Stafford
Ginders, Samuel...Ingestre, Stafford
†Glover, John...Bangley, Tamworth
Glover, Robert...Wexford, Lichfield
Gough, Ralph D....Willenhall
Griffin, Alfred E....Wolverhampton
Griffin, George F....Tillington, Stafford
Griffin, Thomas J....Preston Vale, Penkridge
Grindley, William...Weeping Cross, Stafford
Hambleton, A. P....Harley Thorn, Newcastle
†Hardy, John, M.P..Dunstall Hall, Burton-on-Trent
Hardy, Richard...Marchington, Uttoxeter
Hartill, J....Willenhall, Wolverhampton
Hatherton, Lord...Teddesley, Penkridge
Heatley, J. H....Engleton Hall, Penkridge
Heatley, Thomas...Pattingham, Wolverhampton
Heaton, Thomas...Castle Hill, Alton, Cheadle
Hewson, John Dale, M.D....Coton Hill, Stafford
Hibbit, A. W. W....Penkridge
†Higgs, J. Birch...Brewood, Penkridge
Hills, Alfred...The Copplce, Penkridge
Hills, William A....Hammerwich, Lichfield
†Holland, Dr. C ...St. Chads, Lichfield
Holland, William...Streethay, Lichfield
Hollis, Henry W....Keele, Newcastle
Holloway, Joseph...Tutbury, Burton-on-Trent
Horsfall, T. B....Bellamour Hall, Rugeley
Hulme, Thomas...Endon, Stoke-on-Trent
Inge, Charles H....Whittington Hurst, Lichfield
Inge, Rev. George...Thorpe Constantine, Tamworth
Ingram, H. F. M....Hoar Cross, Rugeley
James. John...Sandon Hall Farm, Stone
James, Thomas...Shushions Manor, Church Eaton
Jenkinson, F....Marston, Stafford
Jenks, Thomas...Orton, Trysull, Wolverhampton
Jenks, William...Upper Penn, Wolverhampton
Jervis, Hon. E. Swinfen...Aston Park
Keeling, C. R....Yew Tree Farm, Penkridge
Keeling, G. B....Hampton House, Penkridge
Kendrick, Edward...Weeford, Lichfield
Knight, Edward...Sandon, Stone
Knight, John L....Barton-under-Needwood
Knight, Josiah...Milwich, Stone
†Kynnersley, C. T. Sneyd...Highfields, Uttoxeter
Landor, W. J....Lee Hall, Rugeley
Lawrence, J. W....Chesterfield Grange, Lichfield
Lea, R. N....Doveridge, Stoke-upon-Trent
†Leaver, Francis...Longnor Hall, Penkridge
Lewis, Samuel...Audley, Newcastle
Lewisham, Viscount...Patshull, Wolverhampton
Lichfield, Earl of...Shughorough
†Locker, William T....Aston, Stone
Lovatt, Henry...Finchfield House, Wolverhampton
Loveridge, Charles...Ivetsey Bank, Penkridge
†Loveridge, Samuel...Chapel Ash, Wolverhampton,
Lowe, Edward...Comberford Mill, Tamworth
Lowe, Thomas...Trysull, Wolverhampton
Madan, Martin...Haselour, Tamworth
†Manley, A. E....Manley Hall, Lichfield
Marson, John ..Acton Mill, Stafford
Martin, E. Hall, jun....Barr Hill, Madeley
Masfen, R. H....Pendeford, Wolverhampton
†Masfen, William...Norton Caines, Cannock
Matthews, Charles..Cleveland Road, Wolverhampton
†May, G. A....Elford Park, Lichfield
Mayou, J. Webster...Fazeley, Tamworth
Meakin, H. J....Shobnall Grange, Burton-on-Trent
Mein, William...Brewood, Stafford
Mellard, Ralph...Rugeley
Menzies, George...Trentham, Stoke-on-Trent
Meredith, David...Yeatsall, Rugeley
Miller, J. Norton...Pattingham, Wolverhampton
Minor, A. Henry...Kiddermore, Penkridge
Mitchell, John...The Beacon, Penkridge
†Monckton, Francis...Stretton Hall, Penkridge
Moore, R....Rye Hill, Church Eaton, Stafford
Morris, A....Pendeford House, Wolverhampton
Morris, Sir John. Whitewick House, Wolverhampton
Mosley, Sir Tonman, Bart....Burton-on-Trent
Mott, William...Wall, Lichfield
†Mynors, W. C. T....Elford Lowe, Tamworth

†Negus, Thomas A ...Lynn House, Walsall
†Newdigate, F. W..Byrkley Lodge, Burton-on-Trent
Oldacres, Walter...Broadfields, Lichfield
Page, Francis...Uttoxeter
Pearson, J. C....Newbridge, Wolverhampton
Peel, Right Hon. Sir R., Bart., M.P....Drayton Manor, Fazeley
†Peile, Rev. T. W....Cannock Vicarage
Perkins, J....Manstey Farm, Penkridge
Perry, William...Hickmerclands, Sedgley, Dudley
Pigot, Sir R., Bart....Patshill, Wolverhampton
Plant, Edward...Little Onn, Stafford
Plant, Henry W. C....Burley Fields, Stafford
Pole-Gell, H. Chandos...Footherly Hall, Lichfield
Poyser, Josiah T....Burton-on-Trent
Pratt, Edward...Caldwell, Burton-on-Trent
Princep, William...Newton, Tamworth
Pursell, R. R....Oxley, Wolverhampton
Radford, H. B....Stanton House, Burton-on-Trent
†Ridgway, John...Shelton, Stoke-on-Trent
†Roberts, Oscar W....Fisherwick Park, Lichfield
Robotham, A....Drayton Basset, Tamworth
†Rogers, Henry...Wolgarstone, Penkridge
Rogers, W. H....Goldthorne Villa, Wolverhampton
Salt, Thomas...Weeping Cross, Stafford
Sankey, Thomas...Burntwood, Lichfield
Senior, James...The Pennicroft, Stafford
Shaw-Hellier, Capt....Wimborne, Wolverhampton
†Shrewsbury and Talbot, Earl of...Ingestre, Stafford
Smith, Henry...Summerhill, King Swinford, Dudley
†Smith, T. Carrington...Admaston, Rugeley
Sollom, Francis...Pennfields, Wolverhampton
Southwell, Frederick C....Rugeley
Stanley, Henry..Yield Field Hall, Bloxwich, Walsall
Strongitharme, G....Rushall, Walsall
Stubbs, Charles...Preston Hill, Penkridge
Stubbs, John...Burston House, Stone
Stubbs, Richard...Stone
Stubbs, Samuel...Bridgford, Stafford
Stubbs, Thomas...Hammerwich, Lichfield
Stubbs, William...Rickerscote, Stafford
Summerfield, J....Green Barn, Lichfield
Swift, George...Hanchurch, Newcastle
Taylor, George...Dudley
Taylor, Henry...Pattingham, Wolverhampton
Taylor, William...Barnhurst, Tettenhall
Thomas, William...Pennfields, Wolverhampton
Thompson, William...Walton, Stone
Tildersley, James...Willenhall, Wolverhampton
Timmis, Charles...Brick House, Stafford
Tomkinson, William...Newcastle
Tongue, Edward...Manor House, Aldridge, Walsall
Troutbeck, George...Barton-under-Needwood
†Tudor, G. S....Park House, Lapley, Penkridge
Tunnicliffe, E. T....Bromley Hall, Eccleshall
†Turnor, E. Weston...Brereton, Rugeley
Twentyman, A. C....Castlecroft, Wolverhampton
†Vaughan, Edmund M....Lapley, Penkridge
Walker, Matthew..Stockley Park, Burton-on-Trent
Walker, Robert Hay...Chillington, Wolverhampton
Walker, Samuel...Tutbury, Burton-on-Trent
Wallworth, George...Bridgeford, Stone
Wallworth, Joseph...Walton Hurst, Eccleshall
Walters, Stanley...Blythebury, Rugeley
†Wardle, Henry...Stanton House, Burton-on-Trent
Warner, James...Tixall Hall Farm, Stafford
Warrington, William...Bretby, Burton-on-Trent
†Waterpark, Lord...Doveridge Hall, Uttoxeter
†Wight, C. B....Rudge Hall, Wolverhampton
†Williamson, Hemhall...Greenway Bank, Burslem
Winterton, Thomas...Alrewas Hay, Lichfield
Wood, John...Draycot-in-the-Clay, Uttoxeter
Wood, Willoughby...Holly Bank, Burton-on-Trent
Woodcock, Richard..Darlington St., Wolverhampton
Woolf, Thomas...Standon Hall, Eccleshall
†Woolley, Thomas...Newton Regis, Tamworth
Wright, R. Merry...Coppenhall, Stafford
Wright, S....l'Onn, Church Eaton, Stafford
Wright, T. B....The Quarry House, Great Barr
†Wrottesley, Lord...Wrottesley, Wolverhampton
†Wyatt, Robert...Acton Hill, Stafford
†Wyley, James...Longdon, Rugeley

SUFFOLK.

Governors.

†Stradbroke, Earl of....Henham Park, Wangford
†Wilson, Lt.-Col...Stowlangtoft, Bury St. Edmund's.

Members.

Allix, W. T....Campsea Ash, Wickham Market
†Anstruther, J. H. L....Hintlesham Hall, Ipswich
Arnold, Rev. Richard A....Ellough, Beccles
†Atkinson, W....Great Rapers, Bures St. Mary's
Badham, G. D....Bulmer Tye, Sudbury
Barlow, Major F....Hasketon, Woodbridge
Barnardiston, N. C....The Ryes, Sudbury
†Barthropp, N. G....Hacheston, Wickham Market
Baskett, Nathaniel...Wetheringsett, Stonham
†Bates, George W...Northgate St., Bury St. Edmund's
†Bence, Capt....Kentwell Hall, Long Melford
Bence, Henry A....Thorington Hall, Saxmundham
Benyon, Rev. E. R....Culford, Bury St. Edmund's
†Berners, John...Holbrook, Ipswich
Bevan, Beckford...Bury St. Edmund's
Bevan, William R....Bury St. Edmund's
Biddell, G. Arthur...Ipswich
†Biddell, Herman...Playford, Ipswich
†Biddell, Manfred...Playford, Ipswich
†Biddell, William...Lavenham Hall, Sudbury
Blundell, Arthur...Chediston Hall, Halesworth
†Boby, Robert...Bury St. Edmund's
Boldero, John...Rattlesden, Woolpit
Brooke, H....Wetheringsett, Stonham
Brooke, John W....Sibton Park, Yoxford
†Browne, Colvile...Park House, Long Melford
†Bunbury, Sir C., Bart....Great Barton Hall, Bury St. Edmund's
†Burrell, R....Westley Hall, Bury St. Edmund's
Byford, William...The Court, Glemsford
†Cartwright, R. Norton...Flixton, Bungay
Chapman, William...Orwell Place, Ipswich
Chase, Henry...Stanton Hall, Ixworth
†Clayton, E. E...Guildhall Street, Bury St. Edmund's
Cobbold, John Chevallier...Ipswich
†Cobbold, John Patterson...Ipswich

Cocksedge, James S....Stowmarket
Cooke, Rev. J. Youog...Semer, Ipswich
Cooke, Robert C....Livermere, Bury St. Edmund's
†Cooper, C. B....Fakenham Hall, Ixworth
Cooper, G. Kersey...Bowbeck House, Ixworth
Cooper, J. R.....Barton, Bury St. Edmund's
Cooper, Thomas W....Bury St. Edmund's
Corrance, F. S., M.P....Broadwater, Framlingham
Crisp, Arthur W....Gedgrave Hall, Woodbridge
De Grey, Hon. and Rev. F..Copdock Rectory, Ipswich
Eagle, Alfred...Boxted, Bury St. Edmund's
†Easterson, Thomas...Bawdsey, Woodbridge
Edwards, G. Betham...Bredfield, Woodbridge
Elwes, Hugh W. H....Stowe Park, Bungay
†Everitt, W. S....Carlton Colville, Lowestoft
†Fison, Albert J....Barningham Hall, Ixworth
Fison, Joseph...Ipswich
†Fowler, Robert C....Gunton Hall, Lowestoft
Freeman, Edward...Creeting All Saints, Stonham
Freeman, John G...,.Aspall House, Debenham
French, Richard Day...St. John's, Buogay
Freuer, Alfred...Debenham, Ipswich
†Frost, Charles...Wherstead, Ipswich
Garrard, Frank R....The Hall, Framlingham
Garrard, Robert..Brundish Grove, Wickham Market
†Garrett, Richard...Carleton Hall, Saxmundham
Gilstrap, Wm...Fornham Park, Bury St Edmund's
†Gobbitt, John...The Grove, Hollesley, Woodbridge
Greene, Edward, M.P...Westgate, Bury St. Edmund's
Grimwade, Edward...Ipswich
Grout, John...Woodbridge
†Gurteen, Daniel...Haverhill
Guy, George F....Angel Hill, Bury St.Edmund's
Harvey, William...Timworth, Bury St.Edmund's
Harwood, Thomas...Belstead Hall, Ipswich
Haward, Robert...Mells Hill, Halesworth
†Hawkins, Thomas...Bentley Hall, Ipswich
Hayward, Frederick...Needham Market
Head, John...Ipswich
†Hempson, John A....Erwarton Hall, Ipswich
Henniker, Lord...Woodlands, Ipswich
Hervey, Lord A., M.P..Ickworth, Bury St.Edmund's
†Hodgson, E. G...Charsfield Hall, Wickham Market
Horton, Capt. W., R.N..Livermere, Bury St.Edmund's
†Jacobson, C. C....Whatfield, Ipswich
Jillings, F. V....Saxham, Bury St. Edmund's
Jillings, John...Little Saxham, Bury St. Edmund's
†Kerrick, John...Geldeston Hall, Beccles
Kerry, T. R...Lockford, Bury St. Edmund's
King, A. C..Desning Hall, Higham, Bury St. Edmuud's
King, Walter John...Ipswich
King, W. N....Barton, Bury St. Edmund's
Larkman, G. J....Coldecott Hall, Fritton, Lowestoft
Lee, Charles...Bramfield, Saxmundham
Leech, George...Hundon Great Lodge, Haverhill
Le Grice, Henry...Market Hill, Bury St. Edmund's
†Lugar, Henry...Ingham, Bury St. Edmund's
Lungley, Brooke M....Peyton Hall, Boxford
Manfield, W....Ixworth Thorpe, Bury St. Edmund's
†Mills, William...Saxham Hall, Bury St. Edmund's
Mumford, G. S....Lavenham, Sudbury
†Mumford, Maurice...Creeting, Stowmarket
Nunn, G. H....Eldo House, Bury St. Edmund's
Oakes, Hervey A....Stowmarket
†Ogilvie, Alexander...Leiston, Saxmundham
Oldrin, John...Rushmere, Wangford
†Packard, Edward...Ipswich
†Packe, Dr. J....Melton Lodge, Woodbridge
Paine, George J....Risby, Bury St. Edmund's
Paine, W. Denton...Chevington, Bury St. Edmund's
Palmer, George...Hawstead, Bury St. Edmund's
Parker, J. Oxley...Drinkstone, Woolpit
Parker, Lt.-Col. Windsor, M.P., Clopton Hall, Woolpit
Pashley, A. W....Haddiscoe, Lowestoft
Payne, George E....Badwell Ash, Ixworth
Peto, Lawrence J....17, Esplanade, Lowestoft
†Pettiward, R. J....Firborough Hall, Stowmarket
†Powell, T. Harcourt...Drinkstone Park, Woolpit
†Prentice, Manning...Stowmarket
†Pretyman, Arthur...Haughley Park, Stowmarket
Ransome, J. Allen...Ipswich
Ransome, J. E....Bolton Hall, Ipswich
Ransome, Robert C....Ipswich
Read, Henry...London Road, Beccles
Rendlesham, Lord...Rendlesham Hall, Woodbridge
Rodwell, B. B. H..Ampton Hall, Bury St. Edmund's
†Sexton, G. Mumford...Wherstead Hall, Ipswich
Sikes, John...Sudbury
Sims, W. Dyllwyn...Ipswich
Smith, John F....Glemsford, Sudbury
Stearn, Samuel G....Brandeston, Wickham Market
†Steward, A. A....The Lodge, Lound, Lowestoft
Sturgeon, Joseph...Norton Hall, Woolpit
†Talbot, H...Stanningfield Hall, Bury St. Edmund's
Thornhill, T., Jun...Packenham, Bury St. Edmuud's
Townshend, George...Oulton Cottage, Lowestoft
Turner, Edward R. T....Ipswich
Turner, Frederick...Ipswich
Turner, J. H....Little Horringer Hall, Bury St. Edmund's
Waller, Thomas...Sutton Hall, Woodbridge
Ward, David...Melford, Sudbury
Warner, Edward...Stowmarket
Webb, Lancaster...Combs Tannery, Stowmarket
Wells, Henry...Occold, Eye
White, Rev. J....Chevington, Bury St. Edmund's
†Whiting, T. C....Barsham House, Beccles
Whitmore, William...Wickham Market
Wigston, Richard....Horningsheath, Bury St. Edmund's
Wilkinson, Captain T. H....Walsham, Ixworth
Wilkinson, H. J....Walsham-le-Willows, Ixworth
†Wilson, H. Maitland....Stowlangtoft, Bury St. Edmund's
Wilson, William...Baylham Hall, Ipswich
Wolton, H....Newbourn Hall, Woodbridge
†Wolton, S....Butley Abbey, Wickham Market
Woods, E. Freeman...Stowmarket
†Woods, James...Stowmarket
Woodward, R....Rise Hall, Akenham, Ipswich
Wollard, Joseph...Broxted Lodge, Hundon
Wright, Herbert...Ipswich
Youngman, Philip...Walsham-le-Willows, Ixworth

SURREY.

Governors.

Barclay, Hedworth D.... Eastwick Park, Leatherhead
Lovelace, Earl of. East Horsley Towers, Woking Stat.

Members.

†Amos, C. E..5, Cedars Rd., Clapham Common, S.W.
†Arbuthnot, John A....Cowarth, Chertsey
Armstrong, George...Thoruton Heath
Baker, G. W..48, Cambridge Terr., Clapham Rd., S.W.
Bates, Robert Jackson..Ditton Hall Lodge, Kingston
†Beaumont, J. A....Park House, Wimbledon
Bennett, Rev. H. Leigh...Thorpe, Egham
†Best, J. V...32, Guildford Rd., South Lambeth, S.E.
Bigg, T....Leicester House, Great Dover Street, S.E.
Binney, Charles H....North Cheam
†Birch, George Francis...Clare Park, Farnham
†Blenkinsop, James...Egham
Bosanquet, S. Courthope...Tanhurst, Dorking
Botly, William...Salisbury Villa, Upper Norwood
†Bradshaw, John...Knowle, Cranleigh
†Breach, J. G....Upper Richmond Road, Putney
Bridgland, Stephen...Springfield, Tooting
Briggs, Thomas...The Homestead, Richmond
†Bushby, H. J....Henleaze, Kingston Hill
Butcher, W....Bowling Green Farm, Ewell
Cabrera, General...Wentworth, Chertsey
Chadwick, E., C.B...Park Cottage, East Sheen
Chitty, Edward...Guildford
Clowes, George...Oakhill, Surbiton
Clutton, Robert G....Hartswood, Reigate
Cobb, George Henry...Oakwood, Upper Norwood
†Coles, Alfred...Clifton Lodge, Clapham Park
Combe, R. H....Pierrepont, Frensham, Farnham
Coussmaker, Lannoy...Westwood, Guildford
Cressingham, Jonah...Carshalton
Currey, Charles Herbert...Weybridge
Currie, Henry...West Horsley Park, Leatherhead
Curzon, Hon. S. C. H. R....Grove House, Tooting
Devas, Thomas...Mount Ararat, Wimbledon
Drewit, Thomas...Piccard's Farm, Guildford
Eggar, James...Bentley, Farnham
†Ellis, John...Artington, Guildford
†Elston, Captain W....St. Ann's Road, Brixton
Eyre, Robert T....Riverdale, Surbiton, S.W.
†Faviell, W. F....Down Place, Guildford
Fletcher, John...Merton Hall Farm, Merton
†Forster, Samuel...Southend, Sydenham
Franks, James...Bramley, Guildford
Frederick, Sir R., Bart...Burwood Park, Walton-on-Thames
Fuller, Robert Willes...Croydon
Gadesden, Augustus W....Ewell Castle
Giles, F. Thresher..Marsh House, Bentley, Farnham
Goodson, William...Hill Farm, Mitcham
†Gossett, Major Arthur...West Park, Mortlake
Gower, Granville W. G. L....Titsey Park, Godstone
Grantley, Lord...Wonersh Park, Guildford
†Gray, G. W. ...Gatton, Reigate
†Grissell, Thomas...Norbury Park, Dorking
Hales, Edward...The Waldrons, Croydon
Hall, Charles...Brickwood Villa, Croydon
Harbord, Collet...Cranleigh, Guildford
Healey, E. C....Wyphurst, Guildford
Hepburn, Thomas...Clapham Common
†Hicks, Sir Francis, Bart....Oakfield, Streatham Hill
†Hicks, Thomas...Holmewood, Streatham Hill
†Hipwell, G. M....Elmore Lodge, Sutton
†Hodgson, J. Stewart...Denbigh, Haslemere
Houlder, Edwin...Fernwood, Sutton
†Hughes, Frederick...Wallfield, Reigate
Hunter, Lt.-Col..Downe House Villa, Richmond Hill
†Johnson, Cuthbert W.... Waldronhurst, Croydon
Josling, G. F....Arbrook Farm, Esher
†Kesterton, Thomas...Sutton
King, Hon. J. P. Locke, M.P...Woburn Park, Chertsey
King, R. Fuller...Lavender Road, Battersea
Kingsbury, E. W....5, Effra Road, Brixton
†Lambert, Henry T....Sandhills, Bletchingley
Lascelles, F. H....Mayfield, Rawledge, Farnham
Lees, John...Reigate
†Lefroy, C. J. Maxwell...Crondall, Farnham
Linley, William...Ham Common
Lintott, James, jun....Bedford Park, Croydon
†Luttman-Johnson, J...Gostrode Farm, Chiddingfold
†MacNiven, Charles...Perrysfield, Oxted
Martin, E. Waterer...Nonsuch Park, Ewell
†Master, C. Hoskins...Barrow Green House, Godstone
†Michell, E. W., jun..Halken, Queen's Rd., Richmond
Molyneux, J. More...Losely Park, Guildford
†Morris, Norman...Ford, Lingfield
Musgrave, Rev. Vernon...Hascombe, Godalming
Newton, John...Manor Road, Bermondsey, S.E.
Northey, E. R....Epsom
Ord, George...Brixton Hill
†Paine, Mrs....Farnham
†Paine, W. Dunkley...Cockshutt Hill, Reigate
Parson, Rev. W. H....Lynchmere, Haslemere
Pennington, Frederick...Broome Hall, Dorking
Pinckard, G. H....Coombe Court, Godalming
Priest, Alfred...Kingston-on-Thames
Puckle, T. B....Woodcote Grove, Carshalton
Pugh, W. C....Woburn Road, Bedford Park, Croydon
†Punnett, P. S....Park Hill Road, Croydon
†Ramsden, J. C....Busbridge Hall, Godalming
Ranford, Charles, New Weston St., Bermondsey, S.E.
Rayner, Captain...Beulah Hill, Upper Norwood
†Roberts, C. Gay...Haslemere
†Ross, Owen C. D....Little Bookham, Leatherhead
†Rowcliffe, E. Lee...Cranleigh, Guildford
Sadler, Thomas...Chiddingfold
†Saunders, W. Wilson...Hillfield, Reigate
Sawyer, Henry G....Richmond Park
Scott, T. E....Liverpool Road, Kingston Hill
†Scott, William C....Thorpe, Chertsey
Seager, J. Lys..Carroun House, South Lambeth, S.E
Seawell, Thomas A....Marelands, Farnham
†Shaw, John...Beddington Lodge, Croydon
Simpson, George...Wray Park, Reigate
Smith, George R....Selsdon Park, Croydon
Smithers, William...Quarrie, Bletchingley
Steere, Lee, M.P....Jayes Park, Dorking
Stenning, Edward...Stratton House, Godstone
†Stevens, Alfred Henry...Farnham
Still, Henry...Chelsham, Croydon
†Stilwell, J. J. R....Killinghurst, Haslemere

†Taber, John...Herne Hill
†Thurlow, T. Lyon...Baynard Park, Guildford
Tredwell, John...Leigham Court, Streatham Hill
†Vaux, Lord (of Harrowden)...Highams, Bagshot
Vivian, Major-Gen. Sir R. J. H., K.C.B....Caterham
Walker, Marmaduke...Addington Lodge, Croydon
Ware, James T....Tilford House, Farnham
Waterer, Anthony...Knapp Hill, Woking
Wetton, Henry...Chertsey
†Wigsell, Captain...Sanderstead Conrt, Croydon
Winchester, The Bishop of...Farnham Castle
Wise, Henry...Feltons, Brickham, Reigate
†Wood, George...Hatchlands, Guildford
Woolloton, Charles...Elstree, Nutfield
Woolnough, William...Kingston-on-Thames

SUSSEX.

Governors.

Allison, Arthur...Tilgate Forest Lodge, Crawley
Allison, Charles F....Tilgate Forest Lodge, Crawley
Chichester, Earl of...Stanmore Park, Lewes
Curteis, Major Edward Barrett...Leesam House, Rye
Egmont, Earl of...Cowdray Park, Petworth
†Freeland, H. W....Chichester
†Leconfield, Lord...Petworth House
Montefiore, Joseph Meyer...Worth Park, Crawley
†Richmond, Duke of, K.G....Goodwood, Chichester
†Shadwell, Lucas...Fairlight, Hastiugs

Members.

†Aldridge, Major J....St. Leonard's Forest, Horsham
†Anson, Sir Johu, Bart....Avisford, Arundel
Arkcoll, Thomas...The Meads, Eastbourne
Baker, William H....Brooklands, Worthing
Bannister, Thomas...Limehurst, Hayward's Heath
Barchard, F...Horsted Place, Uckfield
Baring, John...Oakwood, Chichester
Bennett, Sir J...The Banks, Mountfield, Hurst Green
Blencowe, John George...Binenam, Lewes
Blencowe, Robert Willis...The Hook, Lewes
Body, John...The College, Wittersham, Peasmarsh
Bourne, John..Bugsell Farm, Salehurst, Hurst Green
Brahy, James...Mayhanks, Rudgwick, Horsham
Brander, R. B....Tanbridge House, Horsham
Brook, A. Sawyer...Bexhill, Hastings
†Brown, Thomas...Buckham Hall, Uckfield
Bunny, Major Edward John...Slinfold, Horsham
Caffin, Peter...Hazelwick, Crawley
Cane, Edward...Berwick, Lewes
†Carew-Gibson, G. C....Sandgate Lodge, Pulborough
†Cavendish, Lt.-Col. W. H. F..West Stoke, Chichester
Champney, Felix...Gatwick, Crawley
Clark, George William...Steellands, Ticehurst
Coote, George Cosens...Tortington, Arundel
†Coppard, T....Lanehurst Lodge, Hurstpierpoint
Courthorpe, G. C....Whiligh, Hurst Green
Currie, Edmund...West Burton House, Petworth
Day, John...Newick Lodge, Uckfield
†Dennett, Mullens...Lodsworth, Petworth
†Dickens, Charles Scrace...Coolhurst, Horsham
Dodd, Henry...The Hall, Rotherfield
Drakeford, David...Brookside, Crawley
†Drewitt, George...Oving, Chichester
Drewitt, John...North Stoke, Arundel
Drewitt, R. Dawtrey...Peppering, Arundel
Dumbrell, James...Ditchling
Ellis, Charles...Preston House, Beddingham, Lewes
†Ellman, R. H....Landport, Lewes
Elwes, H. T....West Hoathley, East Grinstead
Emery, R. Coleman...Hurston Place, Storrington
Evershed, Henry...Hallinghy
†Farhall, John N....Tillington, Petworth
Ferard, Charles...21, Palmeira Square, Brighton
Fitzhugh, Rev. William...Street, Lewes
Fletcher, John C....Dale Park, Arundel
†Gates, Richard...7, Sussex Place, Horsham
Gee, Thomas...Dewhurst Lodge, Wadhurst
†Gorringe, Hugh...Southwick, Shoreham
†Grantham, George...Barcombe Place, Lewes
Hale, Bernard...Holly Hill, Hartfield
Hallett, F. F....The Manor House, Brighton
Hampton G....North End, Washington, Pulborough
Hanning, J...Little Oat Hall, Burgess Hill
Hardwick, Alfred...Hangleton, Portslade
Hart, Henry P....Beddingham, Lewes
Heasman, Alfred...Angmering, Arundel
Henry, Captain J....Blackdown House, Petworth
Hersee, Miss...Westgate, Chichester
†Hollist, Hasler...Lodsworth, Petworth
†Hubbard, W. Egerton...St. Leonards, Horsham
†Hume, C. Trevor...The Rectory, St. Leonards
Humphrey, Henry...Ashington, Hurstpierpoint
Hussey, Edward...Scotney Castle, Lamberhurst
†Innes, William...Field Place, Warnham, Horsham
†Jenner, George...Parsonage House, Udimore, Rye
Johnson, E. W....Chichester
Jollands, W. D....Buxshalls, Lindfield
†Laurie, R. N....Pax Hill Park, Cuckfield
Lucas, J. Clay...Lewes
Lyon, William...Charlwood, Crawley
†Mackenzie, J. H....North Wood, West Hoathley
†Madgwick, William...Alciston, Lewes
Maunington, C....Morley Farm, Battle
Mannington, W....Laughton Place, Hurst Green
†Margary, Major...Chaitham Park, East Grinstead
†Mitford, W. Townley, M.P....Pitshill, Petworth
Morris, W. Rudkin...Silverlands, St. Leonards
Napper, John...Ifold, Horsham
†Nottidge, Josias...Iden Rectory, Rye
Oastler, Jonah...Alfold, Horsham
Oxley, John S....Fen Place, Worth
Pappillon, Thomas...Crowhurst Park, Battle
Peachey, William...Ebernoe, Petworth
†Pipon, Captain...Deerswood, Crawley
†Pratt, Major...Somers, Billingshurst
Pratt, Richard F....Sedlescomb, Battle
Pronger, James...Crawley
†Raikes, G. W...Portslade Cottage, Shoreham
Ratcliffe, R....Standard Hill, Ninfield, Battle
Reeves, J. R....Hantsland, Crawley Down
Rigden, William...Hove, Brighton
Rumhold, C. J. A....5, Percival Terrace, Brighton
Russell, Joseph...Bewhush Farm, Lower Beeding
Sadler, Henry...Mid Lavant, Chichester

Sadler, R. Stebbing...Park Farm, Bolney, Cuckfield
Sampson, Thomas...Moor Hall, Ninfield, Battle
Sheffield, Earl of...Sheffield Park, Uckfield
†Simes, N. P....Stood Park, Horsham
Speaker, Right Hon. The...Glynde, Lewes
Stanford, Alfred...Eatons, Ashurst, Steyning
Stanford, Edward...Ashurst, Steyning
Stanford, Walter...Parham, Pulborough
Stanford, William...Charlton Court Farm, Steyning
Stenning, William...Halsford, East Grinstead
Stutter, John..Hadlow House, Five Ashes, Mayfield
Tallant, Francis...Easebourne Priory, Midhurst
Taylor, William...Glynley, Westham
Thompson, T. C....Ashdown Park, East Grinstead
Turner, Frank...North Bersted, Bognor
Turner, J. Singer...Chyngton Farm, Seaford,
†Upperton, Robert...35, Steyne, Brighton
Upton, Henry...Aldwick, Bognor
Verrall, R. Relfe...Falmer, Lewes
†Warner, Thomas...47, Sussex Square, Brighton
†Warren, R. A....Preston Place, Arundel
Waters, Benjamin...Motcombe, Eastbourne
Watson, Robert...Standard Hill, Ninfield, Battle
Webster, Frederick...Marley Farm, Battle Abbey
Wemyss, M....West Hoathley, East Grinstead
Willett, G. W....2, Royal Crescent, Brighton
Wood, James...Ockley, Hurstpierpoint
Wood, William...Ifield Court, Crawley

WARWICKSHIRE.

Governors.

Hertford, Marquis of...Ragley Park, Alcester
†Howe, Earl...Gopsall, Atherstone
†Leigh, Lord...Stoneleigh Abbey
†Warwick, Earl of...Warwick Castle

Members.

†Adderley, Rt. Hon. C.B., M.P..Hams Hall, Minworth
Adkins, G. C....The Lightwoods, Birmingham
Adkins, Henry...The Firs, Edgbaston, Birmingham
†Allfrey, H.W...Hemingford Ho., Stratford-on-Avon
Angerstein, W. T. N....Ashby Lodge, Rugby
Arnold, Ralph...Shackerstone, Atherstone
Ashwin, Manley C....Stratford-on-Avon
Bacon, Samuel, jun....Ratcliffe Culey, Atherstone
Baker, William...Moor Barns, Atherstone
†Baldwin John...Luddington, Stratford-on-Avon
Baldwin, T...Hockley Heath, Birmingham.
Ball, George...North Kilworth, Rugby
Barrs, Mrs. M...Odstone Hall, Atherstone
Bayzaud, Joseph...Kingley, Alcester
†Bennett, B. E....Theddingworth, Rugby
Bennett, John Ewins...Bosworth Grange, Rugby
Benson, C....98, Bull Street, Birmingham
†Berney, Sir Hanson, Bart....Sheepy, Atherstone
Bomford, H. J....Dunnington, Alcester
Bourne, William...Atherstone
†Brassey, H. A., M.P...Newbold Comyn, Leamington
Brierly, Harry, jun....Church Lawford, Rugby
†Bright, John...Bath Row House, Birmingham
Bromfield, Henry...Flint Hall, Wellesbourne
Bromwich, Thomas...Woolston, Coventry
Brown, James...Moor Street, Birmingham
Bruce, John...Tiddington, Stratford-on-Avon
Bucknill, John C., M.D....Hillmorton Hall, Rugby
Buggins, W....New Oscott, Birmingham.
Burbury, W. P...Croft's Farm, Stratford-on-Avon
†Butler, Hon. C. L....Coton House, Rugby
Caldecott, C. M....Holbrook Grange, Rugby
†Caldecott, Thomas...Rugby Lodge, Rugby
Canning, George H....Shottery, Stratford-on-Avon
†Cartwright, Col. H., M.P....Kineton, Warwick
Chapman, R. H....Upton, Nuneaton
†Chattock, H. H....Solihull
Clare, W. Harcourt...Twycross, Atherstone
Clayton, R. C. B....Clarendon Square, Leamington
Cobb, Frederick...Walton, Warwick
†Congreve, S. B...Harbors Magna, Rugby
†Congreve, T....Peter Hall, Brinklow, Coventry
Cookes, J. M...32, Warwick Street, Leamington
Corbett, C....Broad Marston, Stratford-on-Avon
†Couchman, C....Temple Balsall, Birmingham
†Cowley, W. Payne...Ashby St. Ledgers, Rugby
Crofts, John...Long Lawford Hill, Rugby
†Davis, J. Jeffries...Bickmarsh, Alcester
†Elkins, John Francis...Yelvertoft, Rugby
Evans, Isaac Pearson...Griff, Nuneaton
†Fardon, H. F....7, Braithwaite Road, Birmingham
Fenton, Kirkby...Caldecote Hall, Nuneaton
†Fisher, H. L....Hilborough, Alcester
Fowler, R. jun....14, Bennett's Hill, Birmingham
Furness, Captain M. W....Rugby
†Galton, Darwin...Claverdon Leys, Warwick
Gardner, John...Twycross, Atherstone
†Gee, John...Welford, Rugby
German, George...The Field, Measham, Atherstone
†German, William...Measham Lodge, Atherstone
Gilbert, John...Perry Barr, Birmingham
Gillott, T. L....Broadgate, Coventry
Greenaway, G. C...Binswood Cottage, Leamington
†Grimes, W. H....Bubbenhall, Kenilworth
Hamer, Charles M....Snitterfield, Stratford-on-Avon
†Hamilton, Sir R. N. C., Bart., K.C.B...Avon Cliffe, Stratford-on-Avon
†Hammerton, George...Princethorpe, Rugby
Hartopp, Sir J., Bt....Fair Oaks Hall, Sutton Coldfield
Henniker, Captain T. H....Bulkington, Rugby
Hicken, John...Dunchurch, Rugby
Horley, Thomas, jun....The Fosse, Leamington
Howman, Henry A....Halloughton, Coleshill
Hurlston, William...Heathcote, Wasperton
Izon, J. B....Walsgrave-on-Sowe, Coventry
Jones, George...Starton, Kenilworth
†Jones, J. C....Loxley, Warwick
Keep, J. S....Russell Street, Birmingham
Lea, Henry...316, Bristol Road, Birmingham
†Lovell, Thomas...Winwick Warren, Rugby
Lowe, John...Whitmore House, Birmingham
Luckcock, Howard...Edgbaston, Birmingham
Lucy, Rev. J....Hampton Lucy, Stratford-on-Avon
†Lythall, F....Radford Hall, Leamington
Malcolm, Matthew...Manor House, Kineton
Manley, Major...Mancetta Lodge, Atherstone
Mapplebeck, W. B....Bull Ring, Birmingham

Margetts, John...High Street, Warwick
†Mathews, Jeremiah...Edgbaston, Birmingham
†Miles, Grosvenor...Bourton House, Rugby
†Mills, J. Truman...Husbands Bosworth, Rugby
Milne, Oswald, jun,...Leamington
Minett, Junius E..Llowley Hall, Fillongley, Coventry
Moore, George...Appleby Hall, Atherstone
Moore, John...Church Street, Warwick
†Morrice, John W....The Tower, Calthorpe, Rugby
†Mott, C. J....Clifton-on-Dunsmore, Rugby
Moxon, T. David...Easeuhall, Rugby
†Muntz, G. F....Umberslade Park, Birmingham
Newdigate, C. N., M.P....Arbury, Nuneaton
Newton, T. H. G....Barrells Park, Henley-on-Arden
†Norman, John N....Harboro' Magna, Rugby
†Nutt, John...White House, Fillongley, Coventry
Parsons, C. W....Anstrey, Atherstone
Paske-Jones, G....3, Euston Place, Leamington
Pennington, Richard...Westfield House, Rugby
Perkins, W. H...Amesby, Theddingworth, Rugby
Petre, Edward...Whitley Abbey, Coventry
Philips, Mark...Snitterfield, Stratford-on-Avon
†Pratt, C. Alfred...Shenton, Nuneaton
Ratcliffe, T....Norton House, Sheepy, Atherstone
Reading, William...Ashorn, Leamington
Ridley, W. Wells...The Abbey, Southam
†Rigg, Joseph...Fillongley, Coventry
†Riley, Luke...Meriden, Coventry
Robinson, R....Fenny Drayton, Nuneaton
Round, D. G....Edgbaston, Birmingham
Ryland, Thomas..Gt. Lister St. Works, Birmingham
Savidge, John...Gopsall Farm, Atherstone
†Scriven, Edward..Wormleighton Hill, Leamington
Senhouse, Captain W....Ashby St. Ledgers, Rugby
Seymour, R. A....Kinwarton Rectory, Alcester
†Smith, Charles...Dunchurch Hall, Rugby
Smith, F. D. Lea...Halesowen Grange, Birmingham
Smith, George...Ailston House, Stratford-on-Avon
Smith, Joseph...Henley-in-Arden
†Smith, W. B....Beauchamp Terrace, Leamington
Smithson, G. ...63, Wellington Road, Birmingham
Spark, William...Shilton House, Coventry
Spencer, John...Villiers Hill, Kenilworth
Steedman, George...Hall Green, Birmingham
Swinnerton, Robert...Weddington, Nuneaton
†Swinnerton, W. W....Styvechall Grange, Coventry
†Tangye, Richard...Birmingham
†Tipper, B. C....Bristol Road, Birmingham
Tyndall, F. T....Edgbaston, Birmingham
†Umbers, Edward...Wappenbury, Leamington
Villiers, Lady E...Serlhy Hall, Husband's Bosworth, Rugby
Wakefield, W. T....Fletchamstead Hall, Coventry
Walker, G. H....Newbold Grange, Rugby
Wallington, George...Little Hill, Wellesbourne
Watkin, John...Oil Mill, Leamington
Webster, Samuel...St. Mary's Place, Leamington
†Welchman, F. R....Southam
West, J. R....Alscot Park, Stratford-on-Avon
†Weston, James...Stoneleigh, Kenilworth
Whitmell, J. J....Silsworth Lodge, Rugby
†Williams, H. E....Handsworth, Birmingham
Wise, George...Woodcote, Warwick
Witherington, John...Germany House, Rugby
Wood, James...Pinwall Hall, Atherstone
†Wood, John...Welford, Rugby

WESTMORELAND.

Governor.

Bective, Lord...Underley Hall, Kirby Lonsdale

Members.

Alcock-Beck, William...Hawkshead, Windermere
†Argles, F. Atkinson...Eversley, Milnthorpe
Atkinson, William...Burnside Hall, Kendal
Banks, John Jackson...Kendal
Bell, John...Breaks Hall, Appleby
†Braithwaite-Wilson, C...Plumtree Hall, Milnthorpe
Browne, George...Troutbeck, Windermere
†Brunskill, Stephen...Sand Area, Kendal
Cropper, James...Ellergreen, Kendal
Dixon, Thomas...Dalton, Burton
Fenton, David Henry..70, Strickland Gate, Kendal
Fulton, A....Sedgwick, Kendal
Gandy, Lieut.-Colonel...Heaves, Milnthorpo
Gibbon, Henry J....Holmscales, Milnthorpe
†Gibson, Joseph...Whelprigg, Kirkby Lonsdale
†Handley, William...Greenhead, Milnthorpe
†Harris, Alfred...Lunefield, Kirkby Lonsdale
†Harrison, Daniel...Kendal
Harrison, John...Nether Levens, Milnthorpe
†Harrison, John...Summerlands, Kendal
†Harrison, T. J....Singleton Park, Kendal
Holme, John...Park Side, Milnthorpe
Johnson, Henry, jun....Kendal
†Keightley, A. D....Old Hall, Milnthorpe
Key, William...Casterton Hall, Kirkby Lonsdale
Long, A. W....Mint Cottage, Kendal
†Lowther, William, M.P....Lowther Castle
Metcalfe, Anthony...Ravenstonedale, Tebay
Morton, John...Skelsmergh Hall, Kendal
Nicholson, John...Kirkby Thore Hall
Parker, Francis...Acorn Bank, Templesowerby
Parker, Rowland...Moss End, Burton
Punshard, F....Underly, Kirkby Lonsdale
Stavart, W....Helsington Laiths, Kendal
†Swainson, Joseph, jun....Kendal
Talbot, John...Milnthorpe
Tattersall, William...St. Anthony's, Milnthorpe
Taylor, Richard...New House, Kendal
Thompson, James...Castle Meadows, Kendal
†Thompson, William...Moresdale Hall, Kendal
Wakefield, W....Birklands, Kendal
†Wakefield, William Henry...Sedgwick, Kendal
Walker, Adam...Denmark House, Kendal
Webster, Crayston...Kendal
Welch, Henry T....Leck Hall, Kirkby Lonsdale
†Wilkinson, Charles...Bank House, Kendal
Williamson, Benjamin...Kendal
†Wilson, Christopher W....Oxenholme, Kendal
Wilson, G. Crowle...Dallam Tower, Milnthorpe
†Wilson, George E....Dallam Tower, Milnthorpe
Wilson, Thomas...Conswick Hall, Kendal
Yeates, G. H. B....Brettargh Holt, Milnthorpe

WILTSHIRE.

Governors.

†Bath, Marquis of...Longleat, Warminster
Cowley, Earl...Draycot House, Chippenham
†Morrison, Alfred...Fonthill House, Hindon

Members.

Allen, James D....Tisbury, Salisbury
Andrews, Henry...Wylye, Heytesbury
†Arkell, Thomas...Pen Hill Farm, Swindon
Attwater, J. Gay...Britford, Salisbury
Baily, Rev. H. G....The Vicarage, Swindon
Bathurst, Lieut.-Col....Clarendon Park, Salisbury
Beaven, James...West Leaze Farm, Swindon
Blathwayte, G. W., jun....Dyrham, Chippenham
Bolam, C. G....Savernake Forest, Marlborough
Brown, George...Avebury, Calne
Brown, J. Washbourne...Uffcott, Swindon
†Brown, Thomas...Horton, Devizes
Brown, William...Devizes
Brown, W. J....Hazlebury House, Chippenham
Buckley, General E. P....New Hall, Salisbury
†Butler, Paul...Down Ampney House, Cricklade
†Butler, William...Badminton, Chippenham
Churton, E. W....Oldbury-on-the-Hill, Chippenham
Clarke, J. S....Ashwick's Grange, Chippenham
Coles, Robert...Middleton Farm, Warminster
Compton, T....Fisherton Delamere, Heytesbury
Dangan, Viscount...Draycott House, Chippenham
†Day, William...Woodyates, Salisbury
†Ferris, T....Manningford Bohune, Pewsey
†Ferris, W....Manor House, Milton, Pewsey
Galpin, Thomas P....Little Langford, Heytesbury
Goddard, H. N..Manor House,Cliffe, Wootton Bassett
Goddard, W. Gilbert...Broad Chalk, Salisbury
Godwin, Robert...Water Eaton, Cricklade
Graves, Robert...Charlton, Ludwell, Salisbury
†Hanbury, Edgar...Eastrop Grange, Highworth
Harding, William...Cranborne, Salisbury
Hatherell, J. C....Oldbury-on-the-Hill, Chippenham
Hayter, Tom John...West Woodgates, Salisbury
Heneage, G. H. Walker...Compton Bassett, Calne
Hewer, William...Sevenhampton, Highworth
†Heytesbury, Lord...Heytesbury.
Hill, George J....White Heath, Malmesbury
Hitchcock, Rev. J....Chitterne, Heytesbury
Hobbs, Charles...Maisey Hampton, Cricklade
Humby, J. H....Charlton Farm, Salisbury
†Ingram, John A....Wylye, Heytesbury
†Jones, H. P....Portway House, Warminster
Knatchbull, Rev. W....Cholderton Lodge, Amesbury
Lane, Ebenezer...Honey Street, Marlborough
Law, Rev. R. V....Christian Malford, Chippenham
Little, Edward...Lan Hill, Chippenham
†Long, Richard P....Rood Ashton, Trowbridge
Ludlow, H. G. G....Heywood House, Westbury
Lywood, Edwin...Maddington, Devizes
Mannings, George...Downton, Salisbury
Marshall, H. J....Poulton Priory, Cricklade
May, Charles Neale...Devizes
†Merriman, Edward B....Marlborough
†Merriman, Thomas B....Marlborough
†Merriman, William C....Marlborough
Methuen, Lord...Corsham Court, Chippenham
Middleditch, E. T....Blansdon House, Highworth
†Miles, Charles W....Burton Hill, Malmesbury
†Parry, Joseph...Allington, Devizes
†Phipps, C. P....Chalcot House, Westbury
Picton, Robert...Box, Chippenham
†Pollen, R. H....Radbourne, Chippenham
Powell, John Thomas...Easton, Pewsey
†Poynder, T. H. A....Hartham Park, Corsham
†Prodgers, Herbert...Kington House, Chippenham
Radnor, The Earl of...Coleshill, Highworth
Rawlence, James...Bulbridge, Wilton, Salisbury
Read, James...Salisbury
Reeves, Robert...Bratton, Westbury
Rigden, R. H....Salisbury
Robson, William...Wilton, Salisbury
Ruck, Edmund...Castle Hill, Cricklade
†Sadler, James H....Purton Court, Purton
Sainsbury, W..Hunt's Ho., West Lavington, Devizes
†Saunders, T. B....The Priory, Bradford-on-Avon
Smith, R. Sadler...Durrington, Salisbury
Somerset, John...Milton, Pewsey
Spencer, John...Bowood, Calne
†Spicer, J. W. Gooch...Spye Park, Chippenham
Squarey, Elias P....Odstock, Salisbury
†Starkey, J. Baynton...Spye Park, Chippenham
†Storrar, Robert...Grittleton, Chippenham
†Stratton, Joseph...Alton Priors, Marlborough
Stratton, W....Kingston Deverill, Warminster
Suffolk, Earl of...Charlton, Malmesbury
Taunton, William...Redlynch, Salisbury
†Taylor, S. Watson...Erlestoke Park, Devizes
†Thompson, John...Badminton, Chippenham
Viveash, Oriel...Berwick Bassett, Swindon
Whitaker, John S....Bratton, Westbury
Williams, Charles...Salisbury
Winthorpe, Rev. Benjamin...Chippenham
†Wood, W. Bryan...Branbridge, Chippenham
Yonge, Rev. W. J....Rockbourne, Salisbury

WORCESTERSHIRE.

Governors.

Holland, Edward...Dumbleton Hall, Evesham
†Knight, F. Winn, M.P....Wolverley, Kidderminster

Members.

Allsopp, Henry...Hindlip Hall, Worcester
Armitage, W. Sugden...Bickmarsh Hall, Redditch
Ashmore, John...Norton, Evesham
†Ashton. T. Henry...Temple Laugherne, Worcester
†Bailey, Henry James...Rosedale Farm, Tenbury
Baker, Thomas...Blackstone, Bewdley
Barker, David Wilson...Mayfield House, Worcester
†Barneby-Lutley, J. H....Brockhampton, Worcester
†Bearcroft, E....Mere Hall, Droitwich
Beeston, William...Kidderminster
Beman, Thomas...Weston Subedge, Broadway
†Berkeley, Robert...Spetchley Park, Worcester
Best, James, jun....Hill Top, Tenbury
Blick, John...Hill Court, Droitwich

Blyth, Thomas W....Aldington, Evesham
Bomford, Benjamin...Pitchill, Evesham
Boucher, A. E....Wolverley, Kidderminster
Boulter, Thomas...Shenstone House, Kidderminster
†Bourn, James...Studley, Redditch
Bramwell, Henry...Crown East Court, Worcester
Brewster, Richard...Heathy Mills, Kidderminster
†Brown, W. H....Belbroughton, Stourbridge
†Buck, Albert...Sansome Terrace, Worcester
Bull, J. H. W....Great Wolford, Shipston-on-Stour
Burlingham, Henry...Lansdown, Evesham
†Burnham, W. H..Long Compston, Shipston-on-Stour
Chamberlain, Henry...Bredicot Court, Worcester
†Clarke, Robert B....Temple Laugherne, Worcester
Colvile, General...Kempsey House, Worcester
Coney, William...Battenhall, Worcester
Cooke, William H....Skelsley Kimp, Worcester
Cookes, John R....Wood House, Stourport
†Corbett, W. A....Dumbleton, Evesham
Coventry, Earl of...Croome Court, Kempsey
†Crump, G. W....Woolashill, Eckington, Pershore
Curtler, T. G....Bevere House, Worcester
Davis, Stephen...Woolashill, Pershore
†Davis, Thomas Henry...Orleton, Worcester
Dorrell, Thomas...Bishampton, Pershore
Downing, I....Turner's Hill, Rowley Regis, Dudley
Downing, J. Marshall...Dowles, Bewdley
Dudfield, Benjamin...Kinlet, Bewdley
†Dun, Finlay...Weston Park, Shipston-on-Stour
†Evans, E. Bickerton...Whitbourne Hall, Worcester
Fardon, J. A....Witton House, Droitwich
Firmstone, W. C...Rockingham, Hagley, Stourbridge
Fuggle, T. G...Crown Hotel, Worcester
Gibbs, Philip H....Eckington, Worcester
Gilbert, Joseph...Evesham
Giles, John...Chaddesley Corbet, Kidderminster
Goodwin, Frederick...Britannia House, Worcester
Gough, Ashwin D...Hinton, Evesham
Grazebrook, George...Stourbridge
Green, Alfred...Kinwarton, Redditch
Green, John...Heath Grange, Worcester
Griffin, George...Torton, Kidderminster
Guilding, Richard...Brick Barns, Malvern Wells
Halford, Thomas...Newbold, Shipston-on-Stour
Hall, Benjamin...Wood Farm, Malvern Wells
Hancox, Edward O....Evesham
Hardy, Peter...The Grange, Claines, Worcester
Harris, Thomas...Stonylane, Bromsgrove
Harward, John...Chaddesley Corbet, Kidderminster
Haywood, E. W....Sillins, Redditch
Hemming, Richard...Bentley Manor, Bromsgrove
Herring, Henry...Caldwell Farm, Kidderminster
Higginbotham, John...Pensax Court, Tenbury
Hill, John...Severn Stoke, Worcester
†Hill, Thomas R....Catherine Hill House, Worcester
Holder, William...Upper Sapey, Worcester
Holtom, W. F....Cleeve Prior, Evesham
†Hornyold, J. V...Blackmore Park, Upton-on-Severn
Humphries, E....Pershore
Hunt, George...Avon View, Evesham
Lakin, Henry...Link End, Malvern
Larkworthy, J. L....Worcester
Lea, John W... Stansfield House, Worcester
†Lechmere, Sir E. A. H., Bt., Rhyd Ct., Upton-on-Severn
Lett, John...Stone Court, Kidderminster
Lett, William...Rushock, Droitwich
Lloyd, Robert...Offmore, Kidderminster
†Lord, Captain J. P....Great Malvern
Lunn, Robert...Norton, Evesham
M'Cann, George...Court Farm, Malvern
Middlemore, Colonel...Thorngrove, Worcester
Middlemore, Mrs....Thorngrove, Worcester
†Midgley, W. H....Inchbrook, Malvern Link
†Moore, Henry...Elmley Castle, Pershore
†Moseley, Captain W. H....Leaton Hall, Stourbridge
†Munn, Frederick...Holt Castle, Worcester
†Mynors, R....Weatheroak, Alvechurch, Bromsgrove
Neville, John, jun....Alvechurch, Redditch
Noel, Captain C. P....Bell Hall, Stourbridge
†Nott, James...Penn Hall, Eardiston, Tenbury
Padmore, Richard...Worcester
Page, Joseph...Stoke Prior, Bromsgrove
Pakington, Right Hon. Sir J., Bart., M.P...Westwood Park, Droitwich
Parker, Rev. W....Little Comberton, Pershore
†Philips, Sir G. R., Bart. Weston Ho., Shipston-on-Stour
Phipps, Thomas...Bricklehampton, Pershore
Pippett, William...Caughton House, Bromsgrove
Prance, Courtnay C....The Elms, Evesham
Randell, Charles...Chadbury, Evesham
Randell, James R....Chadbury, Evesham
Rich, S....Cedars, Fearnale Heath, Worcester
†Sheldon, H. J....Brailes House, Shipston-on-Stour
Sherriff, A. C., M.P....Worcester
Smith, Henry William...Evesham
Smith, Ralph...Lenchwick, Evesham
†Smith, Sir W., Bart....Eardeston, Tenbury
Smithin, Benjamin...Dumbleton, Evesham
Smithin, J....Wadborough, Kempsey, Worcester
†Southall, Thomas...Worcester
Stallard, John...Worcester
Stallard, Josiah...The Blanquettes, Worcester
Stamford and Warrington, Earl of...Enville House, Stourbridge
Stephens, George...Fladbury, Pershore
Taylor, Henry...Elmbridge Green, Droitwich
Tomson, James...Barnt Green, Redditch
Trinder, T....Sandlin, Leigh Sinton, Malvern
†Vernon, Harry Foley...Hanbury Hall, Droitwich
Walker, G. I. Alexander...Norton, Worcester
Wall, Thomas...The Ford Farm, Droitwich
†Walton, H. L....Burmington, Shipston-on-Stour
†Watkins, J. G....Woodfield, Ombersley, Worcester
†Watson, John...Waresley, Kidderminster
Webb, Edward, jun....Wordsley, Stourbridge
Webb, Frederick Pace...Evesham
Webb, Henry...14, Foregate Street, Worcester
Webb, James...Fladbury, Pershore
Webb, William...Worcester
†Wheeler, E. V....Kyrewood House, Tenbury
Wheeler, John...Long Compton, Shipston-on-Stour
Whitford, Richard...Avon Side, Evesham
†Wilson, John Wilson...Broadway, Evesham
Woodward, R....Ardley Castle, Bewdley
Woodward, Thomas...Severnstoke, Worcester

YORKSHIRE.

Governors.

†Aldham, William...Frickley Hall, Doncaster
†Cathcart, Earl...Thornton-le-Street, Thirsk
†Childers, John W....Cautley Hall, Doncaster
Fitzwilliam, Earl, K.G...Wentworth, Rotherham
Johnstone, Sir H., Bt., M.P..Hackness Hall, Scarboro'
Ripon, Marquis of...Studley Royal, Ripon
†Thompson, Harry Stephen...Kirby Hall, York
Zetland, Earl of...Aske Hall, Richmond

Members.

†Akroyd, Edward, M.P....Bank Field, Halifax
†Ambler, Henry...Watkinson Hall, Halifax
Angas, George...Beeford Grange, Lowthorpe, Hull
†Atchison, William...Bowling Works, Bradford
†Athorpe, J. C....Dinnington Hall, Rotherham
†Auckland, Lord...Doncaster
Baldwin, William H....Normanton Hall
Bamlett, A. C....Thirsk
†Barber, Thomas...Sproatley Rise, Hull
Barker, Edward...Pickburn, Doncaster
Barroby, Miss E....Dishforth, Thirsk
†Barstow, C. D....Garrow Hill, York
†Barton, J. Hope...Stapleton Park, Pontefract
Bartram, William...Harrogate
Baxter, Benjamin...Elslack Hall, Skipton
Baxter, Robert...Doncaster
Beachel, John...Rawcliffe, Selby
Beaumont, E. B....Woodhall, Barnsley
Beckitt, Richard...Watton Abbey, Driffield
Benington, T...,.Hall Gate, Cottingham, Hull
Bentley, Robert John...7, Hall Cross, Doncaster
Best, Robert Storr...Moorfields, Goole
Bethell, William...Rise, Beverley
Beverley, Mathew B....Leeds
†Bolton, Lord...Bolton Hall, Bedale
Booth, John B....Killerby, Catterick
Booth, Thomas C....Warlaby, Northallerton
Borton, John...Barton-le-Street, Malton
Botterill, John...Eppleworth, Cottingham, Hull
†Briggs, Rawdon...Birstwith Hall, Ripley
†Bromet, William R....Cocksford, Tadcaster
†Brooke, William...Northgate House, Huddersfield
†Broomhead, B. P....Broomhall Park, Sheffield
Brown, Douglas...Ancliffe Hall, Northallerton
Brown, William...Holme-on-Spalding Moor, York
Carlin, William, jun....Keyingham, Hull
Cayley, Sir Digby, Bart....Brompton, York
Chaloner, Admiral...Longhull, Guisborough
Chambers, George...High Green House, Sheffield
Champneys, Rev. T. P....Badsworth, Pontefract
†Charlesworth, John...Middlestown, Wakefield
†Charlesworth, J. Barff...Hatfield Hall, Wakefield
Charlton, Thomas...Newland, Middlesborough
†Cholmley, H. W....Newton Hall, Rillington]
Cholmley, Sir George, Bart....Howsham, York
†Clark, Frederick J. P....North Ferriby, Hull
Clarke, John W....Guisborough
†Clay, Charles...Walton Grange, Wakefield
Clayton, T. Greenwood..,Ousecliff, York
Cleasby, Thomas M....Wilton Grange, Redcar
†Clutton, William James...The Mount, York
†Cocking, W. F....Crowle, Doncaster
Coleman, John...Escrick Park, York
Collison, William...Beverley
†Comber, Thomas...Redcliffe, Newton-le-Willows
Cookson, William J....Denton Park, Otley
Corner, Edward...Esk Hall, Whitby
Corringham, R. W....Lound House, Haxey, Bawtry
Coulman, Edward...Levels, Thorne
Coulman, John...Red House, Thorne
†Croft, A. H....Aldborough Hall, Boroughbridge
Crosby, J. M....73, Newboro' Street, Scarborough
Crosskill, Alfred...Beverley
†Crow, George...Ornhams, Boroughbridge
Croysdale, John...Whitley Bridge, Pontefract
Cuthbert, Robert...Patrick Burmpton, Bedale
Danby, F....Middledale, Kirbygrindalyth, York
Darley, Charles A....Burtonfield, York
Davison, Richard...Driffield
Dawson, George...Thorncliffe, Sheffield
Day, Richard...Hodroyd Hall, Barnsley
Deane, Patrick...High Street, Hull
Denison, Edmund...Doncaster
†Dent, John Dent, M.P....Ribston Hall, Wetherby
Dent, Joseph...Ribston Hall, Wetherby
†De Wend, W. Fenton...Underbank Hall, Sheffield
Dudding, Thomas...Pockerby, Goole
Duncombe, Hon. Adm...Kilnwick Percy, Pocklington
Dunn, Jonathan...Kelfield Lodge, York
Durham, Makin...Thorne
Dyke, Francis Hart...3, Museum Street, York
†Eddison, R. W....Headingley Hill, Leeds
†Eddison, William...Huddersfield
Edwards, Sir H., Bart., M.P....Pye Nest, Halifax
Ellershaw, Charles...Bossall, York
Elston, William...Bank House, Selby
†Farrer, H. R....Green Hammerton
Fenton, Ferrar...Wakefield Road, Dewsbury
Feversham, Earl of...Duncombe Park, Helmsley
Fisher, Edward...Grove Hill, Beverley
Fisher, John...Carhead, Crosshills, Leeds
Ford, John...Tancred, Whixley, York
Foster, John...Fockerby, Goole
Fowler, Robert...Leeds
†Fox, G. Lane...Bramham Park, Tadcaster
†Frank, F. Bacon...Campsall Hall, Doncaster
Garbutt, Thomas...Yarm, Cleveland
Gartside, Henry...Wharmton Tower, Greenfield, Saddleworth
Gauntlett, W. Henry...Middleshoro'-on-Tees
Green, Robert...Scalby, Scarborough
Gibbs, Thomas...Sledmere, York
Gilpin-Brown, George...Sodbury Park, Richmond
Gothorp, James...Mowbray Hill, Bedale
Gouthwaite, Richard...Lumby, South Milford
†Greenwood, John...Swarcliffe Hall, Ripley
†Greig, David...Leeds
†Gunter, Captain R....Wetherby
†Halifax, Viscount...Hickleton Hall, Doncaster
†Hall, Charles E....22, Grove Terrace, Leeds
Hall, James...Scarboro' Hall, Beverley
†Hardacre, Richard...Hellifield, Leeds

†Harewood, Earl of...Harewood House, Leeds
†Harland, H. Seaton...Brompton, York
Hathorn, A....Smeathalls, Ferrybridge
Hepworth, Joshua...Rogertborp, Pontefract
†Herries, Lord...Everingham Park, Pocklington
Hewson, Frederick...The Haven Farm, Tickhill
†Hildyard, J. G. B. Thoroton..Winestead Hall, Hull
†Hildyard, J. R. W.....Hutton Bonville Hall, Northallerton
Holroyd-Bradbury, G. E. H....Longroyde, Rastrick
Hodgson, W....Falsgrove, Scarborough
Hudson, C. Herbert...Sandall Grove, Doncaster
Hutchinson, T. H....Manor House, Catterick
†Jaques, Leonard...Wentbridge House, Pontefract
Jaques, R. M....Easby Abbey, Richmond
Jaques, T. G....Blacktoft, Howden
Jefferson, Rev. J. D....Thicket Priory, York
Johnson, T. C....Chevet, Wakefield
†Johnstone, J. C. Hirst...Field Head, Thorner, Leeds
Jordan, J. Staveley...Elmswell, Driffield
†Kaye, J. E....Bretton Park, Wakefield
†Kirk, Richard...Gale Bank, Wensleydale
Kitson, James...Leeds
Knowles, James...Wetherby
†Lambert, C....Sunk Island, Otteringham, Hull
Langdale, G. W....Leconfield Park House, Beverley
†Lascelles, Hon. G. E....Sion Hill, Thirsk
Laverack, S. S....Redness Hall, Goole
†Lawley, Hon. and Rev. S. W..Escrick Rectory, York
Lee, Charles...Newton House, Bedale
†Londesborough, Lord...Grimston, Tadcaster
†Lupton, Arthur...Headingley, Leeds
Macfarlan, Walter...Chapel Thorpe, Wakefield
†McLaughlin, W. G....Helmsley, York
Mangles, George...Givendale Grange, Ripon
Markham, Lt.-Col. W. T..Becca Hall, Milford Junction
†Marshall, Arthur...Headingley, Leeds
†Marshall, Edmond H....Westwood Hall, Leeds
†Marshall, J. Garth...Headingley, Leeds
Martin, S. D....1, Park Place, Leeds
Masterman, T. J....Little Danby, Northallerton
Matthews, Francis Cooke...Driffield
Mellows, William...High Melton, Doncaster
Mills, R. W. F....Lendal, York
†Moorsom, C. R....Harewood, Leeds
†Morrison, Walter, M.P....Malham Tarn, Skipton
Morrison, William H....Wood Hall, Barnsley
Moscrop, W. J....Olliver, Richmond
Nicholson, Brady...Stourton Grange, Garforth, Leeds
Nicholson, Thomas....100, Lowther Street, York
Norfolk, Richard...Beverley
†Normanby, Marquis of...Mulgrave Castle, Whitby
Nowell, W. Atkinson....Netherside, Skipton
Owen, William...Rotherham
Pardey, James E....Newton-le-Willows
Parker, T. J....10, George Street, Sheffield
Paver, William...Peckfield, Milford Junction
†Phillips, J. H....Beadlam Grange, Nawton, York
†Pilkington, Sir L. M. S., Bart., Chevet Pk., Wakefield
†Powell, Rev. S. H....Sharon Hall, Ripon
†Preston, Captain J. N....Flasby Hall, Gargrave-in-Craven
Preston, T....Scostbrop House, Bell Busk, Leeds
Preston, Thomas H....Moreby Hall, York
†Pulleine, James...Clifton Castle, Bedale
†Ramsden, Sir J. W., Bart...Byram, Ferrybridge
Richardson, G....Bridlington Quay
Richardson, H....Cherry Hill, York
Riggall, R. W....Smeathalls, Ferrybridge
†Riley, Edmond...Kipling Cotes Farm, Hull
†Ringrose, R. B....Swanland, Brough
Roberts, G. C....8, Wright Street, Hull
Robinson, G. J....Maunby, Thirsk
Robinson, J. T....Leckby Palace, Asenby, Thirsk
Robinson, T....Nuthill, Hedon, Hull
†Rockett, John H....Goole
Rounding, Thomas...Fraisthorpe, Bridlington
†St. Leger, Colonel...Park Hill, Rotherham
Salt, Sir Titus, Bart....Crow Nest, Halifax
Saltmarshe, Philip...Saltmarshe, Howden
Shann, Charles...Inholes, Tadcaster
Sharp, Isaac...Middlesborough-on-Tees
†Shawe, R. Fleetwood...Lotherton Hall, S. Milford
†Smith, Henry F....Lamwath House, Sutton, Hull
Smith, J. Jeffreston...Wortley, Sheffield
†Smith, J. Metcalf...Leeds
Smith, William...Goole Grange, Goole
Stamper, T....Highfield House, Oswaldkirk, York
†Stapylton, Major...Myton Hall, Borougbbridge
Staveley, John...Dotterill Park, Driffield
Staveley, Simpson...Tibthorpe Manor, Driffield
†Stickney, Walter M....Hull
Stickney, William...Ridgmont, Holderness
Stott, Miss...Eccleshill Hall, Leeds
†Strickland, C. W....Boynton, Bridlington
†Sykes, C., M.P....Brantingham Thorpe, Brough
Taylor, F. Howard...Middlewood Hall, Barnsley
†Taylor, G. E....Langthorpe House, Boroughbridge
Tempest, Colonel...Tong Hall, Leeds
Tennant, J. Mason...Headingley, Leeds
Tennant, John R....Kildwick Hall, Leeds
†Tennant, Robert...Scarcroft Lodge, Leeds
Tennant, Thomas...Blenheim Terrace, Leeds
Thompson, Leonard...Sheriff Hutton Park, York
†Thornes, Joseph...Green House, Ossett, Wakefield
†Tiffen, Joseph...Minster Corner, Beverley
Tinker, Henry...Holmfirth, York
Toulson, John Parker...Skipworth Hall, Selby
Townend, Edward...The Nook, Bingley, York
†Walker, F. James...Claxton Hall, York
Walker, James R....Sandhutton, York
†Walker, John...Mount St. John, Thirsk
Walker, Thomas...The Woodlands, Doncaster
Walker, Thomas S....Maunby Hall, Thirsk
Walker, William...Victoria Works, York
Walmsley, G....Rudston House, Bridlington
Waterhouse, Samuel, M.P....Halifax
Welby, E. M. Earle...Norton Leas, Sheffield
†Wells, John...Booth Ferry, Howden
†Wenlock, Lord...Escrick Park, York
Wentworth, Godfrey H....Woolley Park, Wakefield
Wharton, G. Livingstone...Grove Hill, Beverley
Wharton, Rev. J. C....Gilling Vicarage, Richmond
†Wharton, J. T....Skelton Castle, Guisborough
Wheatley, John...Neswick, Driffield
Whitaker, B. Ingham...Hesley Hall, Rotherham

Wiley, Samuel...Brandsby, York
†Williamson, W. E....Catterick
Willis, Thomas...Manor House, Carperby, Bedale
Wilmot, R. C....Woolley Park Farm, Wakefield
†Wilson, John...Seacroft Hall, Leeds
Wilson, Matthew...Eshton Hall, Gargrave, Leeds
Winter, Richard...The Levels, Thorne
†Wombwell, Sir G. Bart....Newburgh, Easingwold
Wood, Richard...Potternewton, Leeds
Woodd, Basil T....Conyngham Hall, Knaresborough
†Woodyear, Rev. J. F. W....Crookhill, Doncaster
Wright, Sir William...Sigglesthorne, Holderness
†Wrightson, R. H....Warmsworth Hall, Doncaster
†Wrightson, W. B....Cusworth Park, Doncaster
†Wyse, Robert...Auburn Hill, Malton
†Yeoman, G. Dundas...Woodlands, Whitby
†Yeoman, R. C...Marsk Hall, Marsk by the Sea
†Yorke, T. E....Halton Place, Hellifield, Leeds

CHANNEL ISLANDS.

Governor.

†Le Conteur, Colonel...Belle Vue, Jersey

Members.

Boyd-Kinnear, John...Courtil, Rozel, Guernsey
Collings, Rev. W. T....Guernsey
Le Cornu, C. P....Trinity Manor, Jersey
Le Feuvre, H. J....Les Nièmes, St. Peters, Jersey
Le Gallais, Albert...La Moire House, Jersey
Lempriere, Rev. W....Rozel Manor, Jersey
Le Page, T. B....St. Andrews, Guernsey
Mourant, Edward...Samare's Manor, Jersey
Rendle, Robert...Catel Farm, Guernsey
†Turner, Lieut.-Colonel F. H....Gouray, Jersey
Watson, Rev. Joshua R....Le Bocage, Guernsey

ISLE OF MAN.

Members.

Cunninghame, Captain...Hensol, Castle Douglas
†Gawne, E. M....Kentraugh

NORTH WALES.

Governors.

Penrhyn, Lord...Penrhyn Castle, Bangor
†Powis, Earl of...Powis Castle, Welshpool
Wynn, Sir W. W. Bt., M.P....Wynnstay, Ruabon

Members.

Adams, Captain A. F....Rhyddyn Hall, Wrexham
†Bankes, J. Scott...Soughton Hall, Northop
†Barnes, J. R....Brookside, Chirk
†Barnes, Thomas...The Quinta, Chirk
Bate, Edward...Kelsterton, Flint
Bell, William...Bodrhyddan, Rhuddlan, Rhyl
Biddulph, R. Middleton...Chirk Castle
Browne, T. B...Mellington Hall, Churchstoke, Mont.
Buddicom, W. B....Penbedu Hall, Mold
Bulkeley, C. Rivers...Bodylltyn, Ruabon
†Bulkeley, Sir R. W., Bart....Baron Hill, Beaumaris
Burnett, Gregory...Dee Cottage, Flint
†Burton, John...Gresford, Wrexham
Chambres, P. H....Llysmeirchion, Trefnant, Rhyl
†Charlton, St. John...Pentreffynon, Holywell
Cooke, B. G. D....Colomendy, Mold
Cotton, F. E....Knowlton Hall, Ruabon
Cotton, General F. Conyers...Cilhendre, Ruabon
Crewe-Read, Capt. R.N....Llandiuam Hall, Montgomery
Darbishire, S. D....Pendyffryn, Conway
Dawson, John...Gronant, Rhyl
Dean, Thomas...Mold
Dennis, Henry...Hafod-y-bwch, Ruabon
Denson, Samuel...Pwllhalog Hall, Rhyl
Dickin, John...Tyndwfr, Llangollen
†Dod, Whitehall...Llannerch, St. Asaph
†Doyle, John A....Plâs Dulas, Abergele
Edwards, Richard...Trewern Hall, Welshpool
†Elwell, E....Nenaddfraith, Newtown
Eyton, John Wynne...Lees Wood, Mold
Farmer, James...Llyssum, Welshpool
†Fitzhugh, Thomas Lloyd...Plâs Power, Wrexham
†Fortune, W....The Drefor, Kerry, Montgomery
†Gillart, Richard...Llynllvedd, Machynlleth
Glynne, Sir Stephen, Bt....Hawarden Castle, Flints.
Griffith, William...Glyn, Dolgelly
Griffiths, John R....Brynderwen, Llanrwst
Griffiths, Samuel...Overton, Flints.
Hare, T. W....Berthddu, Llandinam
Harrison, Rev. R. J....Caerhowell, Montgomery
†Hellyer, G. W. M....Tan-y-Garth, Bettws-y-coed, Llanrwst
Heyward, Major...Crosswood, Welshpool
Hill-Trevor, Lord A. E., M.P....Brynkinalt, Chirk
Hodgson, I. Scott...Sodylt Hall, Ruabon
Hope, S. Pierce...Marchwiel Hall, Wrexham
Hope, T. Radford...Henfryn, Rhyl
†Howard, Robert...Broughton Hall, Wrexham
†Hughes, H. R....Kinmel Park, St. Asaph
Hughes, H. R....Ystrad, Denbigh
†Humberston, P. S....Glan y Wern, Denbigh
Jesse, John F....Llanhedr Hall, Ruthin
†Jocelyn-Ffoulkes, Major...Eriviatt, Denbigh
Jones, Lt.-Col. A. S., V.C...Hafod-y-Wern, Wrexham
Jones, Edward...Park Farm, Caersws
Jones, John...Bryn Adda, Dolgelly
Jones, John...Maesypandy, Tal-y-llan
Jones, Thomas...Summerfield Park, Llanidloes
Jones, William...Blackhall, Newtown
Jones, William...Record Street, Ruthin
Kerfoot, John...Faenol Back, St. Asaph
Kirkby, D. E....Llanfendigaid, Towyn
Kyrke, R. V....Nantyffrith Hall, Wrexham
†Lewis, George...Worthenbury, Wrexham
Lloyd, John...Bôd Lloyd, Ruabon
Lloyd, Joseph...St. Asaph
Lloyd, Llewellyn...Croesnewydd, Wrexham
Lloyd, Llewellyn F....Nannerch Hall, Mold
Mainwaring, Charles S....Galltfaenan, Rhyl
†Mainwaring, Townshend...Galltfaenan, Denbigh
Mathew, E. Windus...Wern, Portmadoc
Meridith, John...The Hildra, Welshpool

Meyrick, Owen Fuller...Bodergau, Anglesey
Miller, Samuel...The Court, Abermule
Moore, John...Kerry, Montgomery
Morgan, Richard...Newtown
†Morris, Thomas...Henfaes, Welshpool
Mostyn, Sir Pyers, Bart....Talacre, Holywell
†Mytton, D. Herbert...Garth, Welshpool
†Naylor, John...Leighton Hall, Welshpool
Newill, Thomas...Spring Bank, Welshpool
Owen, Griffith H....Ymwleh, Tremadoc
†Palmer, Sir Roger W., Bart...Cefn Park, Wrexham
Parmeter, Francis, Jun....Brynyraher, Bala
Parry, William...Towyn
Peel, Edmund...Bryn-y-Pys, Wrexham
Peers, Joseph...Ruthin
†Pennant, P. Pennant...Brynbella, St. Asaph
†Philips, Captain E. W....Rhual, Mold
Pickering, William...Poulton, Pulford, Wrexham
Podmore, Robert...Sealand, Queen's Ferry, Flint
Powell, Evan...Swanside, Newtown
†Price, R. J. Lloyd...Rhiwlas, Bala
Priestley, John...Hirdrefaig, Llangifai, Isle of Anglesey
Pritchard, Robert...Llwydiarth, Esgob, Bangor
Roberts, B. S....Burton Hall, Wrexham
Roberts, F. L....Queen's Ferry, Flint
Rogers, Alfred...Plâs-yn-y-Pentre, Llangollen
Rowley, Hon. R. T..Rbyderddwyn, Faur, Rhuddlan
Ruck, Lawrence..Pantlludw, Machynlleth
†Sandbach, H. R....Hafodunos, Llanrwst
Scott, William...Towyn
Simon, James...Greenfield, Holywell
†Sisson, Robert J....Talardy, St. Asaph
Smith, R. Barclay...Tynewydd, Bangor
Sutton, Ambrose...Althrey, Wrexham
Sykes, John...Croes Howell, Wrexham
Thomas, L. H....Caerffynnon, Talsarna, Caernarvon
Tomlinson, J. H....The Parkey Farm, Wrexham
Trethewy, A. H....Rhyd-y-crena, Llanrwst
Turner, William...Newtown
Vaughan, J. W....Velin Newydd House, Brecon
Williams, David...Dolseran, Dolgelly
Williams, E. A....Gilli, Mold
†Williams, John...Gwernhefin, Bala
Williams, Owen John...Bodelwyddan, St. Asaph
†Williams, R. Ap Hugh...Bodelwyddan, St. Asaph
Williams, Sir Hugh, Bart...Bodelwyddan, St. Asaph
†Williams, W. Granville...Bodelwyddan, St. Asaph
†Williams, Wm....Plasgwyn, Pentraeth, Anglesey
Wood, E. B....Moreton Hall, Chirk
Woosnam, Richard...Glandwr, Llanidloes
Wynne, Brownlow W....Garthewin, Abergele
Wynne, John Lloyd...Coed Coch, Abergele
Wynne, Owen Slaney...Peniarth, Towyn
Wynne, William W. E....Peniarth, Towyn

SOUTH WALES.

Members.

Allen, Henry G....Lawrenny Park, Pembroke
†Bailey, Sir J.R.,Bt., M.P...Glanusk Pk., Crickhowell
†Baird, Alexander...Robeston Hall, Milford Haven
Ball, James...Peterstone Mills, Cardiff
†Bassett, Richard...Bonvilstone, Cardiff
†Boardman, Frederick B....Manoravon, Llandilo
Boultbee, J....Plâs-Gwemant, Newcastle Emlyn
Bowen, James...Troedyraur, Newcastle Emlyn
Bowen, James B....Llwyngwair, Haverfordwest
Bradley, Edward...Cowbridge
Bridgwater, Rees W....Great Porthamel, Talgarth
Buckley, James...Penyfai House, Llanelly
†Budd, J. Palmer...Ystalyfera, Swansea
Cawdor, Earl of...Stackpole Court, Pembroke
Clark, George T....Dowlais House, Merthyr Tydvil
Corbett, John Stuart...Cogan Pill, Cardiff
David, Charles W....Ely Rise, Cardiff
†David, Edward...Llandaff
David, Evan William...Fairwater House, Cardiff
David, John...Ely, Cardiff
Davies, D. Price...Troedyhryn, Llandilo
Davies, John Morgan...Froodvale, Llandilo
Davies, L. T....Llyncuhing, Llanpumpsaint
Davies, Thomas...Parkypratt, Cardigan
Davies, Thomas...Ystradwalter, Llandovery
Davys, W. H. C....Neuadd-fawr, Llandovery
Dunn, Nicholas J....Elm Grove, St. Florence, Tenby
Edwards, D. T....Taff's Well, Cardiff
Ellis, Philip P....Herbrandstone Hall, Milford Haven
†Evans, Henry J....Bank, Cardiff
Evans, James Eaton...Haverfordwest
Evans, J. Jones...Cwmhychan Farm, Pencader
Fitzwilliams, E. C. L....Adpar, Newcastle Emlyn
†Franklin, Richard...Clemenstone, Bridgend
Garsed, John...Llantwit Major, Cowbridge
Goddard, Thomas...St. Fagans, Cardiff
†Gower, Erasmus...Clynderwen, Narberth
†Gower, R. Frederick...Clynderwen, Narberth
Green, Stephen...Haverfordwest
Griffith, John...Llwynduris, Newcastle Emlyn
Griffith, John, jun....Trevorgan, Cardigan
Gulston, A. J....Dirleton, Llangadock
Gwyn, Howel...Dyffryn, Neath
Gwyn, William E. B....Plâs Cwrt Hyr, Carmarthen
Hall, Richard...Baglan House, Neath
Harvey, R. Hart...Slade House, Haverfordwest
Homfray, J. R....Penllyn Castle, Cowbridge
Hopkins, Dr. John...Llantrissant
Howell, J. R....Noyadd Trefawr, Llandyssil
†Hulme, William...The Bank, Pembroke
Huntley, W. V....Welsh St. Donatts, Cowbridge
Insole, J. H....Ely Court, Llandaff
James, David...Cawrence Farm, Cardigan
James, John...Aberclyn, Brecon
James, Richard...High Street, Haverfordwest
Jenkins, David...Flemingstone Court, Cowbridge
Jenkins, R. D....The Priory, Cardigan
Jenkins, Thomas...Pantyscallog, Dowlais
Jennings, Richard...Carmarthen
†Jones, David...Pantglas, Carmarthen
†Jones, John...Blaenos, Llandovery
Jones, Thomas...Talardd, Llanybyther, Carmarthen
Jones, William...Cefn Llogell, Castletown, Cardiff
Jones, Wm....Llwynygroes, Llanwnen, Carmarthen
Jones, William...Pantrewgoch, Castletown, Cardiff
Keeble, George...Colby, Narberth

Leach, Henry...Corston, Pembroke
†Lee, Vaughan H....Lanelay, Llantrissant
Lewes, Colonel John...Llanllar, Talsarn
Lewis, David...Stradey, Llanelly
Lewis, John Lennox G. P....Henllan, Narberth
Lewis, Thomas...Norchard, Tenby
Lewis, W. H....Clynfiew, Newcastle Emlyn
Little, William...Cwmaman, Aberdare
†Llewellin, Richard...Tregwynt, Fishguard
Longcroft, Charles R....Llanina, Aberayron
†Mansell, Sir John, Bart...Maesdilo, Llandilo
Marsh, R....Pen-y-bedd, Burry Port, Carmarthen
Moir, Charles...Cardiff
†Morgan, Major the Hon. Godfrey, C., M.P...Ruperra Castle, Cardiff
Morison, A. J., M.D....Portcleu, Pembroke
Morris, William...Carmarthen
Mousley, T. Turner...Well Field, Carmarthen
†Nicholl, G. W....Llantwit Major, Cowbridge
Norton, Henry...Greenhill, Carmarthen
†Owen, Daniel...Ash Hall, Cowbridge
Owen, William...Withybush, Haverfordwest
Palling, J. G....Castleton, Cardiff
Paramore, J. Rawle...Preswylfa, Neath
Parker, Thomas...Cardigan
Peel, William...Taliaris Park, Llandilo
Penrice, Thomas...Kilvrough, Swansea
Poole, Commander G., R.N..Llangynider, Crickhowell
Powell, D. Jeffreys...The Court, Bronllys, Talgarth
†Powell, W. S....Eglwysnunyd, Taibach
Preece, Thomas...West House, Wick, Bridgend
Price, Alfred B....The West, Bridgend
Pryse, Colonel...Peithyll, Aberystwith
Pryse, John Pugh...Bwlchbychan, Llanybyther
†Pugh, David...Manoravon, Llandilo
†Reece, Edward B....Roath, Cardiff
Reece, R. Lewis...Cardiff
Rees, John...Tile House, Lanmaes, Cowbridge
Rees, John...Hendre, St. Dogmells, Cardigan
Rees, T. Blethyn...Tremunydd, St. Davids
Rees, Valentine...Carmarthen
Rees, William...Penywaun, Lanvabon, Pontypridd
Richards, E. Priest...Cardiff
Roberts, W. B....Lovestone, Pembroke
Romilly, Edward...Porthkerry, Cardiff
†Rosser, William....Llanelly, Carmarthen
Rutzen, Baron F. de...Slebech Hall, Haverfordwest
†Severn, J. Percy...Penybont Hall, Penybont
†Sheild, William H....Lampeter Valley, Narberth
Simpson, John...Pyle Hotel, Bridgend
Spencer, Michael...West Aberthaw, Cowbridge
†Stacey, F. E....Llandough Castle, Cowbridge
Strickland, G....Tretower House, Crickhowell
Talbot, C. R. Mansell...Margam
Thomas, D. Howell...Derllys Court, Carmarthen
Thomas, John...Glanrynis, Kidwelly
Thomas John...Eastfield House, Cowbridge
Thomas, J. Howell...Starling Park, Carmarthen
Thomas, Thomas...St. Hilary, Cowbridge
Traherne, G. M....St. Hilary, Cowbridge
†Turbervill, Major...Ewenny Abbey, Bridgend
Vachell, Edwin...Penarth, Cardiff
Vaughan, Captain Herbert...Brynog, Talsarn
†Vaughan, Nash V. E....Rhesta, Neath
Vivian, H. Hussey, M.P....Park Wern, Swansea
†Walters, William...Haverfordwest
Waring, Thomas...Park Place, Cardiff
Warren, W. de Grouchy...Picton Terr., Carmarthen
Watt, J. W. Gibson...Doldolowe, Radnorshire
Whittaker, S....Stackpole Farm, Pembroke
Whittall, T....Bailey Inon, Llaudrindod Wells
Wienholt, F....Langharne
Williames, Charles H....Roath Court, Cardiff
Williams, John...Llantrithyd, Cowbridge
Williams, John...Caercady House, Cowbridge
Williams, Rees...Pencelly Castle, Brecon
Williams, Rees David...Mannest Court, Brecon
Williams, R. Wyndham...Windsor Villa, Cardiff
Williams, W. Propert...Trehowell, Fishguard
Workman, Henry...Coedkernew, Cardiff
Worthington, G. S....Cardiff
Wright, W. Twaites...St. Nicholas, Cardiff
Yorath, Evan...Moulton Farm, Cowbridge
Yorath, Henry ...13, St. John Street, Cardiff

IRELAND.

Members.

Abercorn, Duke of, K.G....Baron's Court, Newtown Stewart, Tyrone
Bagot, Rev. R. Wolfe...Fontstown, Athy, Kildare
Baldwin, Thomas...Glasnevin, Dublin
Bessborough, Earl of...Pilltown
†Blacker, M. M....Claremont, Claremorris, Mayo
†Bolton, Jasper...Ballykisteen, Tipperary
Bonham, Rev. John...Ballintaggart, Ballistore
Borthwick, John...Prospect, Carrickfergus
†Browne, Lord John T....Westport, Co. Mayo
†Bulwer, Walter Redford..Randalstown, Co. Antrim
Campbell, Arthur J....St. James's Place, Fermoy
Carroll, W. Hutchinson...Tulla House, Nenagh
Castletown, Lord...Granstown Manor, Ballycolla, Abbeyleix
†Caulfield, St. George...Donamor Castle, Roscommon
†Charlemont, Earl of...Charlemont House, Dublin
†Clarina, Lord...Elm Park, Limerick
†Clonbrock, Lord...Clonbrock, Ahaserah
Cooper, E. H....Markree Castle, Colloney, Sligo
†Cosby, R. G....Stradbally Hall, Queen's County
Crawford, W. H....Lakelands, Cork
Crosbie, William T....Ardfert Abbey, Tralee
Digby, Reginald...Geashill Castle, Tullamore
†Doneraile, Viscount...Doneraile Court, Co. Cork
Downing, John...Ashfield, Fermoy
Enniskillen, Earl of...Florence Court, Enniskillen
†Farrell, E. W....3, Merrion Square East, Dublin
Farrell, John Arthur...Moynalty, Co. Meath
Featherstonhaugh, R....Rockview, Killucan
†Filgate, L. G. P....Lisvenney, Ardee
Forster, A. T....Garrettstown, Kinsale
Franks, Thomas..21, Lower Fitzwilliam St., Dublin
Garde, Thomas..Ballinacurra, Middleton, Co. Cork
Garfit, Charles...Queenstown, Co. Cork
Goulding, William...108, Patrick Street, Cork
Greene, John...Millbrook, Magany
Hall-Dare, R. Westley...Newtownbarry House

Hamilton, C. W.... Hamwood, Clonee
†Harman, Hon. L. King...Newcastle, Ballymena
Hawarden, Viscount...Dundrum Castle, Cashel
†Hawkesworth, Richard S.... Forest Mountrath
Henry, Frederick H.... Lodge Park, Straffan
Holmes, W.... Clovervale, Island Magee
†Jones, W. Bence... Lisselan, Clonakilty
Knox, O. N.... Corgrig Lodge, Foynes
Leigh, Francis A.... Rosegarland, Foulksmill
Leslie, C. Powell, M.P.... Glasslough
†Longford, Earl of... Packenham Hall, Westmeath
Low, George... Burghtown, Athy, Kildare
Lurgan, Lord... Brownlow House, Lurgan
Mackenzie, James... Camden Quay, Cork
Mackenzie, W.... 34, Dawson Street, Dublin
†Mahon, H. J. P.... Strokestown House, Roscommon
McClintock, Major... Hillsborough, Co. Down
Mead, W. R.... Ballymartle, Ballinhaseig, Kinsale
Mowbray, Seymour... Kilbany, Mountrath
Naper, James Lenox... Loughcrew, Oldcastle
O'Neil, William... Athy, Kildare
Owen, William... Blessington
Peake, John... Mullaghmore, Monaghan
†Proby, Hon. W.... Glen Art, Arklow
Purdon, Edward... Bachelors' Walk, Dublin
Quinn, Peter... The Agency, Newry
Robertson, J.... 22, Mary Street, Dublin
Rutherford, James... 40, Eccles Street, Dublin
Smith, James... Little Moyle, Carlow
Stawell, Colonel... Kilbrittain, Bandon, Cork
†Stewart, A. J. R.... Ards House, Co. Donegal
Sullivan, Rev. J.... Leopardstown, Foxrock, Dublin
Talbot, George W.... Maryborough, Queen's County
†Templemore, Lord... Dunnoby Park, Wexford
Templeton, Andrew... Ballynafeigh, Belfast
†Templetown, Viscount, Castle Upton, Templepatrick Belfast
†Tighe, Right Hon. W. F... Woodstock Park, Inistioge
†Townshend, C. U.... Burlington Road, Dublin
†Trench, Henry... Cangort Park, Roscrea
†Verner, E. Wingfield, M.P.... The Aske, Bray
Vesey, Lieut.-Colonel.... Lucan House, Dublin
Wade, R. C.... Clonbranie, Crosakeile, Meath
Webber, W. Downes... Kellyville, Athy
†Wilbraham, Hugh... Westport, Co. Mayo
Williams, Francis E.... Derreana Lodge, Waterville
Wise, Josias P.... Rostellan Castle, Cloyne

SCOTLAND.

Governors.

Buccleuch, the Duke of, K.G.... Dalkeith House, Edinburgh
†Dunmore, Earl of... Dunmore

Members.

Armstrong, William Jones... Fairlie, Greenock
†Askew, Sir H. Bt.... Pallinsburn Ho., Coldstream
†Askew, Watson... Pallinsburn, Coldstream
†Aytoun, R. S., M.P.... Inchdairnie, Kirkcaldie
Balfour, David... Balfour Castle, Kirkwall
†Balmer, Thomas... Fochabers
†Beattie, James... Newbie House, Annan
Bethune, Alexander... Blebo, Cupar, Fife
Biscoe, T. P. B.... Kingellie Ho., Newton, Inverness
†Bruce, Thomas R.... Slogarie, New Galloway Station
Burn, R. S.... 1, Linkfield, Musselburgh, Edinburgh
†Calverley, C. C.... University Club, Edinburgh
†Cathcart, R.... Pitcairlie House, Auchtermuchty
Cochrane, James... Harburn, Edinburgh
†Duncan, James... Benmore
Elcho, Lord, M.P.... Armisfield, Haddington
†Findlay, T. Dunlop... Easter Hill, Glasgow
Finlay, A. S.... Castle Toward, Greenock
†Grant, Sir G. M. Bart.... Ballindalloch Castle
†Guthrie, John... Guthrie Castle, Forfarshire
Hale, C. C.... Glenlochay, Killin, Perthshire
†Hamilton, Captain A.... Rozelle, Ayr
†Hamilton, John... Sundrum, Ayr
Higginbotham, S.... Killermont, Glasgow
†Hope, A. Peterkin... Fenton Barns, Drem
Howden, Alexander... Traprain, Preston Kirk
†Hutchison, Robert... Carlowrie, Kirkliston
Kennedy, Rt. Hon. T. F., Dalquharran Castle, Maybole
Kerr, Hugh... St. John's Place, Annan
Kinloch, Colonel... Logie, Kirriemuir
Kinnaird, Lord... Rossie Priory, Inchture
†Lawson, Charles... Borthwick Hall, Gorebridge
†Lawson, Charles, jun.... George Square, Edinburgh
Learmouth, T. L.... Park Hall, Linlithgow
MacDouall, Colonel James... Logan, Stranraer
MacDouall, James, jun.... Logan, Stranraer
McIlwraith, John... Dunure, Ayr
†MacLagan, Peter... Pumpherstone, Midcalder
†Mather, Myles E... Wheatlands, Cramond Bridge, Edinburgh
†Matheson, Sir James, Bart.... The Lewes Island
Maxwell, Sir J. Heron, Bart... Springkell, Ecclefechan
Maxwell, J. R. Heron... Springkell, Ecclefechan
†Maxwell, R. C. Heron... Springkell, Ecclefechan
†Maxwell, Wellwood H., M.P... Munches, Dalbeattie
Milne, David... Paxton House, Berwick
Mitchell, Andrew... Alloa
Ogilvie, John D.... Mardon, Coldstream
Ogilvy, Sir J., Bt., M.P.... Baldovan House, Dundee
†Orde, Sir J. P. W., Bt., Kilmorey Ho., Loch Gilp Head
†Pierson, J. Alexander... The Gwynd, Arbroath
Sadler, William... View Bank, Melrose
Shield, James, Jun.... Upper Ravensdowne, Berwick
†Smith, George P.... Crooks, Coldstream
†Stables, W. Alexander... Cawdor Castle
†Stewart, Mark John... Ardwell House, Stranraer
†Stewart, William M.... Culhorn House, Stranraer
†Stirling-Maxwell, Sir W., Bart., Keir House
†Strathallan, Viscount... Strathallan Castle, Auchterarder
†Taylor, Charles H.... Cornhill, Coldstream
†Thompson, Andrew... Berwick-on-Tweed
Turner, Frederick J.... Dean Castle, Kilmarnock
Turner, John J.... 2, Montague Street, Edinburgh
Vernon, Hon Greville R... Auchans Ho., Dundonald
Wason, Rigby... Covwor, Grivan
†Welsh, John... Kirkton, Hawick
†White, Henry W.... Lentran House, Inverness
†Wilson, Professor John... University, Edinburgh
†Wilson, John... Eddington Mains, Ayton

FOREIGN COUNTRIES.

Members.

†Ahrens, E....New Schlagsdorf, Mecklenburg
†Ananoff, Alexander...Kontais, Russia
†Ananoff, Ivan...Moscow, Russia
†Araujo, Captain F. J. Da Silva...Rio de Janeiro
†Bixio, Maurice...26, Rue Jacob, Paris
†Borie, Victor...14, Rue de Lille, Paris
†Bortier, Monsieur...43, Rue Royal, Brussels
Buckland, George...Toronto, Canada
†Bunsen, G....Bourg-Rheindorf, Bonn
†Cockrane, M. H....Montreal
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†D'Azy, Count Benoist...88, Rue de Grenelle, Paris
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†Decanville, M. Paul...Petit Bourg, Corbeil, France
†De Curzay, Viscount..Chateau de Curzay, Lusignan, France
†De Kergolay, Count...Camisy (Manche), France
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†De Monicault, E...127, Boulevard Haussman, Paris
†Densy, Ernest...Chateau de la Pacandière, Lucay-le-Mâle (Indre), France
†De Vibraye, Marquis...Chateau de Chaverny (Loir et Cher) France
†De Vogüé, Count...37, Rue de Bourgogne, Paris
†De Vogüé, Marquis...2, Rue Tabert, Paris
†De Westphalen, Count Clemens...Laer, Cologne
†Du Buat, Count...Chateau de la Sunardière (Mayenne) France
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