THE

JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY

OF ENGLAND.

VOLUME THE NINETEENTH.

PRACTICE WITH SCIENCE.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1858.

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.

Von Thaer, *Principles of Agriculture.*

London: Printed by William Clowes and Sons, Stamford Street, and Charing Cross.

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APPENDIX.

DIRECTIONS TO THE BINDER.

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), being reprinted without alteration in the Appendix matter retained.

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STATISTICS

OF

THE WEATHER, PUBLIC HEALTH, PRICE OF PROVISIONS, &c., &c.,

FOR THE SIX MONTHS ENDING JUNE 30, 1858.

Extracted from the Quarterly Returns of the Registrar General.

ON

THE METEOROLOGY OF ENGLAND

DURING

THE QUARTER ENDING MARCH 31st, 1858.

By JAMES GLAISHER, Esq., F.R.S.,

SEC. OF THE BRITISH METEOROLOGICAL SOCIETY.

JANUARY.—Till the 7th the air was cold, being 3°·2 below the average; then warm until the 20th, the average excess being 4°·7; again cold till the 27th, the deficiency being daily 4°·2 from the average; and from the 28th to the end of the month warm, being 4°·7 in excess. The mean temperature of the month differed little from the average.

February was cold nearly throughout, excepting on the 3rd, 4th, 5th, 6th, and 13th, when the temperature was somewhat in excess. The mean temperature of the month was nearly 4° below the average.

March till the 12th was cold, the daily deficiency being 8°; from the 13th to the end it was warm, the temperature averaging 5°·3 in excess. This month was nearly of its average temperature.

The greatest differences in the temperature of the air occurred in the Midland counties.

The mean degree of humidity, and the mean temperature of the dew-point, were less than the average value in each month, and in all cases to greater amounts than the deficiency of temperature: therefore the air was less humid than usual.

The reading of the Barometer was nearly half an inch in excess of the average in the month of January; in February slightly above the average; and in March a little in defect.

The fall of rain in January and March was deficient, and in February in excess of the average; it was nearly half an inch in defect on the quarter.

During the three months there was almost a total absence of thunder and lightning.

The mean temperature of the air at Greenwich for the quarter ending February, constituting the three winter months, was 39°, being 1°·3 above the average of 87 years.

THE WEATHER DURING THE QUARTER ENDING MARCH 31, 1858.

1858.	Temperature of								Elastic Force of Vapour.		Weight of Vapour in a Cubic Foot of Air.	
	Air.			Evaporation.		Dew Point.		Air—Daily Range.				
MONTHS.	Mean.	Diff. from average of 87 years.	Diff. from average of 17 years.	Mean.	Diff. from average of 17 years.	Mean.	Diff. from average of 17 years.	Mean.	Diff. from average of 17 years.	Mean.	Diff. from average of 17 years.	Mean.	Diff. from average of 16 years.
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	gr.
January ..	37·5	+1·6	−0·6	35·9	−1·2	33·8	−1·6	12·1	+2·7	·194	−·011	2·2	−0·2
February ..	34·6	−3·7	−3·9	33·0	−4·0	30·4	−4·3	12·0	+0·9	·169	−·034	2·0	−0·4
March	41·4	+0·5	−0·2	38·4	−0·8	34·6	−1·7	17·1	+2·4	·201	−·015	2·3	−0·2
Mean ..	37·8	−0·5	−1·6	35·8	−2·0	32·9	−2·5	13·7	+2·0	·188	−·020	2·2	−0·3

1858.	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.
MONTHS.	Mean.	Diff from average of 17 years.	Mean.	Diff. from average of 17 years.	Mean.	Diff. from average of 17 years.	Amount.	Diff. from average of 40 years.		At or below 30°.	Between 30° and 40°.	Above 40°.		
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
January ..	86	−3	30·171	+·449	563	+10	0·7	−0·6	119	25	4	2	10·2	44·0
February ..	84	−2	29·841	+·063	560	+ 7	1·7	+0·4	83	24	4	0	12·2	39·2
March	78	−4	29·765	−·037	551	0	0·9	−0·2	87	19	9	3	15·0	45·2
Mean ..	83	−3	29·926	+·158	558	+ 6	Sum 3·3	Sum −0·4	Mean 96	Sum 68	Sum 17	Sum 5	Lowest 10·2	Highest 45·2

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

ON

THE METEOROLOGY OF ENGLAND

DURING

THE QUARTER ENDING JUNE 30TH, 1858.

BY JAMES GLAISHER, ESQ., F.R.S.,

SEC. OF THE BRITISH METEOROLOGICAL SOCIETY.

APRIL.—Till the 14th the air was cold, being 4°·2 below the average; from the 15th to the 26th it was warm, the average excess being 5°·9; cold again to the end, 1°·6 below the average. The mean temperature of the month was nearly of its average value.

May was cold till the 15th, being 4°·1 below the average; warm till the 24th, averaging 1°·2 in excess; from the 25th to the 28th cold, being 2°·4 below the average; then hot till the end, being 7°·6 in excess. The mean temperature of the month was about 1° lower than the average.

June was hot throughout, the average excess being above 6°. The mean temperature of this month has been but once exceeded since the year 1771, a period of 87 years; viz. in the year 1846, when it was 65°·3. On the 16th of June, 1858, the temperature near the sea rose as high as 88°, and between the latitudes 51° and 52° reached 95°. The mean temperature of this day at Greenwich was 76°·9—the highest mean temperature in this month on record.

The mean temperature of the dew-point was below its average in April and May, and in June 3° above it. June was less humid than usual, the average excess of air-temperature being greater than that of dew-point temperature.

The mean reading of the barometer was in defect in May, and above the average in April and June; the mean for June being the highest during the last 17 years.

The fall of rain was in excess in April and May, and deficient in June; it was about the average for the quarter.

Thunderstorms were very prevalent in June, some of them being exceedingly violent; particularly one on the 10th in the north-west parts of Dorsetshire; and one on the 16th at Rose Hill, near Oxford, which was preceded by a violent hurricane; the lightning flashed 14 times in about 30 seconds, and the thunder was incessant.

The mean temperature of the air at Greenwich for the quarter ending May, constituting the three spring months, was 46°·4, being exactly of the average value.

The Weather during the Quarter ending June 30, 1858.

1858. Months.	Temperature of Air. Mean.	Air. Diff. from average of 87 years.	Air. Diff. from average of 17 years.	Evaporation. Mean.	Evaporation. Diff. from average of 17 years.	Dew Point. Mean.	Dew Point. Diff. from average of 17 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 17 years.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 17 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour. Diff. from average of 17 years.
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	gr.
April	46·2	+0·5	−0·3	42·7	−0·8	38·7	−1·4	19·6	+1·5	·236	−·014	2·7	−0·2
May	51·7	−0·8	−1·2	47·7	−1·4	43·6	−1·9	21·0	+0·6	·285	−·015	3·2	−0·2
June	64·9	+6·9	+6·2	58·8	+4·2	53·7	+3·1	25·6	+5·2	·414	+·045	4·6	+0·5
Mean ..	54·3	+2·2	+1·6	49·7	+0·7	45·3	0·0	22·0	+2·4	·311	+·005	3·5	0·0

1858. Months.	Degree of Humidity. Mean.	Degree of Humidity. Diff. from average of 17 years.	Reading of Barometer. Mean.	Reading of Barometer. Diff. from average of 17 years.	Weight of a Cubic Foot of Air. Mean.	Weight of a Cubic Foot of Air. Diff. from average of 17 years.	Rain. Amount.	Rain. Diff. from average of 40 years.	Daily Horizontal movement of the Air.	Reading of Thermometer on Grass. Number of Nights it was 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.				°	°
April	76	−3	29·779	+·043	546	+2	2·4	+0·6	73	18	10	2	18·0	42·2
May	75	−1	29·709	−·055	538	0	1·8	+0·3	96	10	7	14	23·8	53·0
June	67	−7	29·915	+·117	527	−4	1·2	−0·7	34	0	2	28	35·0	55·0
Mean ..	73	−4	29·801	+·035	537	−1	Sum 5·4	Sum +0·1	Mean 68	Sum 28	Sum 19	Sum 44	Lowest 18·0	Highest 55·0

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

STATE OF THE PUBLIC HEALTH.

1*st Quarter*.—171,001 births and 125,902 deaths were registered in the first ninety days of the year; and the natural increase of population in that period was therefore 45,099, or 501 daily. The natural increase in the winter quarter of 1857 was 687 daily. The falling off in the increase of population is referable to the excessively high rate of mortality during the past winter; for the births exceeded by 7 daily the births in the winter of 1857. The annual rate of mortality for the three months was 2·627 per cent., or ·155 in excess of the average of the winter quarters of the 10 preceding years, which was 2·472 per cent.

2*nd Quarter*.—169,170 births and 107,193 deaths were registered in the quarter ending on June 30; and the natural increase of the population of England and Wales was 61,977 in 91 days, or 681 daily. The probable natural increase of the population of the United Kingdom was 1021 daily. In the preceding winter quarter it was estimated at 750. The annual rate of mortality for the three months was 2·206 per cent., or ·019 below the average of the spring quarters of the 10 preceding years.

THE PRICE OF PROVISIONS.

1*st Quarter*.—The average price of wheat in the first three months of 1856, 1857, and 1858 was respectively 72*s*. 4*d*., 56*s*. 10*d*., and 46*s*. 5*d*. a quarter. The fall of price since 1856 has been 36 per cent., and since 1857 18 per cent. Beef and mutton by the carcase at Newgate and Leadenhall markets were cheaper in the winter quarter of 1858 than in that of 1857. The price of beef fell from 5¾*d*. to 5¼*d*. a pound, of mutton from 6¼*d*. to 5⅞*d*. a pound. Beef was at the same price, mutton dearer, than in the first three months of 1856. Potatoes attained an exorbitant price, York Regents selling at the waterside market, Southwark, at 152*s*. 6*d*. per ton, 39 per cent. higher than in 1857, and 77 per cent. higher than in 1856.

2*nd Quarter*.—The price of wheat has been for the three months of 1856, 1857, and 1858, 68*s*. 8*d*., 56*s*. 9*d*., and 44*s*. 1*d*. per quarter; of beef for the same periods 5¼*d*., 5⅜*d*., 5⅛*d*.; mutton 5⅞*d*., 5¾*d*., and 5½*d*. a pound. While the price of animal food thus declined, and that of wheat fell 36 per cent., the price of potatoes (York Regents) rose more than 100 per cent., viz. from 80*s*. and 128*s*., to 163*s*. a ton, at the waterside market, Southwark.

THE PRICE OF PROVISIONS.

The AVERAGE PRICES of Consols, of Wheat, Meat, and Potatoes; also the AVERAGE QUANTITY of Wheat sold and imported weekly, in each of the Nine Quarters ending June 30th, 1858.

Quarters ending	Average Price of Consols (for Money).	Average Price of Wheat per Quarter in England and Wales.	Wheat sold in the 290 Cities and Towns in England and Wales making Returns.*	Wheat and Wheat Flour entered for Home Consumption at Chief Ports of Great Britain.*	Average Prices of Meat per lb. at Leadenhall and Newgate Markets (by the Carcase). Beef.	Mutton.	Average Prices of Potatoes (York Regents) per Ton at Waterside Market, Southwark.
			Average number of Quarters weekly.				
1856	£.	s. d.					
June 30	$95\frac{3}{8}$	68 8	104,952	63,093	$4\frac{1}{4}d.$—$6\frac{1}{4}d.$ Mean $5\frac{1}{4}d.$	$5d.$—$6\frac{3}{4}d.$ Mean $5\frac{7}{8}d.$	70s.—90s. Mean 80s.
Sept. 30	95	72 3	78,208	117,807	$4\frac{1}{2}d.$—$6\frac{1}{2}d.$ Mean $5\frac{1}{2}d.$	$5d.$—$7d.$ Mean $6d.$	75s.—80s. Mean 78s.
Dec. 31	$92\frac{6}{8}$	63 4	112,909	103,328	$3\frac{3}{4}d.$—$6\frac{3}{4}d.$ Mean $5\frac{1}{4}d.$	$4\frac{3}{4}d.$—$6\frac{3}{4}d.$ Mean $5\frac{3}{4}d.$	90s.—110s. Mean 100s.
1857							
Mar. 31	$93\frac{4}{8}$	56 10	102,433	51,310	$4\frac{1}{2}d.$—$6\frac{3}{4}d.$ Mean $5\frac{3}{4}d.$	$5\frac{1}{4}d.$—$7\frac{1}{4}d.$ Mean $6\frac{1}{4}d.$	100s.—120s. Mean 110s.
June 30	$93\frac{3}{8}$	56 9	107,850	42,178	$4\frac{1}{4}d.$—$6\frac{1}{2}d.$ Mean $5\frac{5}{8}d.$	$4\frac{3}{4}d.$—$6\frac{3}{4}d.$ Mean $5\frac{3}{4}d.$	105s.—150s. Mean 127s.6d.
Sept. 30	$90\frac{7}{8}$	59 11	92,156	55,384	$4\frac{1}{4}d.$—$6\frac{1}{2}d.$ Mean $5\frac{3}{8}d.$	$4\frac{1}{2}d.$—$7d.$ Mean $5\frac{3}{4}d.$	95s.—115s. Mean 105s.
Dec. 31	$89\frac{1}{2}$	52 0	101,025	95,587	—$6\frac{1}{2}d.$ Mean $5\frac{3}{8}d.$	$4\frac{1}{2}d.$—$7d.$ Mean $5\frac{3}{4}d.$	130s.—150s. Mean 140s.
1858							
Mar. 31	$96\frac{1}{8}$	46 5	99,604	64,652	$4\frac{1}{4}d.$—$6\frac{1}{4}d.$ Mean $5\frac{1}{4}d.$	$4\frac{3}{4}d.$—$7d.$ Mean $5\frac{7}{8}d.$	130s.—175s. Mean 152s.6d.
June 30	$97\frac{1}{8}$	44 1	92,955	86,551	$4\frac{1}{4}d.$—$6d.$ Mean $5\frac{1}{8}d.$	$4\frac{1}{2}d.$—$6\frac{1}{2}d.$ Mean $5\frac{1}{2}d.$	140s.—185s. Mean 162s. 6d.
Col.	1	2	3	4	5	6	7

* NOTE.—The total number of quarters of wheat sold in England and Wales for the 13 weeks ending June 30th, 1856, 1,364,370; for the 13 weeks ending September 30th, 1856, 1,016,704; for the 13 weeks ending December 31st, 1856, 1,467,816; for the 13 weeks ending March 31st, 1857, 1,331,623; for the 13 weeks ending June 30th, 1857, 1,402,051; for the 13 weeks ending September 30th, 1857, 1,198,029; for the 13 weeks ending December 31st, 1857, 1,313,321; for the 13 weeks ending March 31st, 1858, 1,294,855; and for the 13 weeks ending June 30th, 1858, 1,208,420. The total number of quarters entered for Home Consumption was respectively, 820,206; 1,531,489; 1,446,588 (14 weeks); 667,027; 548,315; 719,992; 1,242,628; 840,475; and 1,125,165.

1857.—WEEKLY AVERAGE PRICE OF **WHEAT** FROM GOVERNMENT RETURNS.

	WHEAT.	BARLEY.	OATS.	BEANS.	PEAS.	MAIZE.	FLOUR AND MEAL.
Average of Year	56/5	42/3	25/1	43/1	41/5	..	..
	qrs.	*qrs.*	*qrs.*	*qrs.*	*qrs.*	*qrs.*	*cwt.* *qrs.* *lbs.*
Import of United Kingdom .	3,475,234	1,720,532	1,732,004	309,348	161,896	1,158,752	2,218,462 2 16

STATISTICS

OF

THE WEATHER, PUBLIC HEALTH, PRICE OF PROVISIONS, &c., &c.,

FOR THE SIX MONTHS ENDING DECEMBER 31, 1858.

Chiefly extracted from the Quarterly Returns of the Registrar-General.

ON

THE METEOROLOGY OF ENGLAND

DURING

THE QUARTER ENDING SEPTEMBER 30TH, 1858.

BY JAMES GLAISHER, ESQ., F.R.S.,

SEC. OF THE BRITISH METEOROLOGICAL SOCIETY.

JULY.—Till the 10th the air was cold, being 5°·7 below the average temperature; it became warm until the 25th, the mean excess being 2°·5; from the 25th till the end of the month cold, the average deficiency being 2°·5. The mean temperature of the month was about 1° below the average.

August was warm till the 24th, being 2° above the average; then till the end of the month cold, the average deficiency being 2°·5. The mean temperature was 1°·5 above the average of the preceding 87 years.

September was warm throughout, being 4° in excess of the average. The mean temperature of the month has been but four times exceeded during the last 87 years, *viz.* in the years 1779, 1795, 1815, and 1818, when the mean temperature was respectively 60°·7, 60°·8, 62°·3, and 60°·7.

The mean temperature of the dew-point was below its average in July and August, and above in September. The mean degree of humidity was in defect in each month of the quarter.

The mean reading of the Barometer was in defect in July, and in excess of the average in August and September; it was slightly in excess for the quarter.

The fall of rain was a little above the average in July, one inch below in August, and 1¼ inch below in September; for the quarter there was a deficiency of about half an inch.

Thunderstorms were frequent during the quarter.

The mean temperature of the air at Greenwich for the quarter ending September, constituting the three summer months, was 62°·5, being 2°·5 above the average of 87 years.

The Weather during the Quarter ending September 30, 1858.

1858. Months.	Temperature of Air. Mean.	Air. Diff. from average of 87 years.	Air. Diff. from average of 17 years.	Evaporation. Mean.	Evaporation. Diff. from average of 17 years.	Dew Point. Mean.	Dew Point. Diff from average of 17 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 17 years.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 17 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour in a Cubic Foot of Air. Diff. from average of 17 years.
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	gr.
July	60·6	−0·8	−1·1	55·7	−1·8	51·5	−2·4	22·0	+1·6	·380	−·037	4·3	−0·3
August ..	62·0	+1·5	+0·6	56·5	−1·1	51·7	−2·6	23·5	+4·2	·385	−·041	4·3	−0·5
September ..	60·3	+4·0	+3·4	56·6	+2·7	53·4	+2·4	18·3	−0·3	·408	+·025	4·6	+0·4
Mean ..	61·0	+1·6	+1·0	56·3	−0·1	52·2	−0·9	21·3	+1·8	·391	+·018	4·4	−0·1

1858. Months.	Degree of Humidity. Mean.	Degree of Humidity. Diff. from average of 17 years.	Reading of Barometer. Mean.	Reading of Barometer. Diff. from average of 17 years.	Weight of a Cubic Foot of Air. Mean.	Weight of a Cubic Foot of Air. Diff. from average of 17 years.	Rain. Amount.	Rain. Diff. from average of 40 years.	Daily Horizontal movement of the Air.	Reading of Thermometer on Grass. Number of Nights it was 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.				°	°
July	72	−4	29·781	−·015	529	+2	2·9	+0·2	77	0	2	29	39·0	57·0
August ..	70	−8	29·826	+·029	529	+1	1·6	−0·9	−	0	12	19	32·2	59·3
September ..	78	−3	29·865	+·027	531	−3	0·9	−1·2	101	0	6	24	33·8	55·0
Mean ..	73	−5	29·824	+·014	530	0	Sum 1·8	Sum −0·6	Mean −	Sum 0	Sum 20	Sum 72	Lowest 32·2	Highest 59·3

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.

ON

THE METEOROLOGY OF ENGLAND

DURING

THE QUARTER ENDING DECEMBER 31st, 1858.

By JAMES GLAISHER, Esq., F.R.S.,

SEC. OF THE BRITISH METEOROLOGICAL SOCIETY.

October till the 4th was warm, being 3¼° above the average; cold till the 12th, being 2¾° deficient; from the 13th to the 28th warm, being 3¼° in excess; and then till the end of the month cold, the mean daily deficiency being 5½°. The mean temperature of the month was 50°·8, being 1½° above the average.

November was very cold till the 24th, being 6° below the average, and then became warm for the remainder of the month, the average excess being 5¾°. The mean temperature of the month was 39°·6, being 4¼° below the average of the last 17 years. The mean temperature of this month has been lower on 12 occasions only during the last 87 years. The mean temperature of the 23rd and 24th at Greenwich was lower than that of any two consecutive days in November during the last 45 years.

December was warm till the 5th, being 3¾° in excess; cold till the 17th, averaging 3½° in defect; and for the remainder of the month warm, the average excess being 5¼°. The mean temperature for the month was ½° above the average of the previous 17 years.

The mean temperature of the dew-point was above its average in October and December, and below in November. The mean degree of humidity exceeded its average in December, but was deficient in October and November.

The fall of rain was deficient in each month, and the total deficiency for the quarter amounted to 4·5 inches. The annual fall for the last four years has shown a yearly decrease; in 1855 the amount was 23·5 inches; in 1856, 21·5 inches; in 1857, 21·4 inches; and in 1858, 17·2 inches; and the latter amount is the lowest since 1840, when it was 16·4 inches.

The mean pressure of the atmosphere was considerably above the average in October, and somewhat below in November and December.

The mean temperature of the air at Greenwich for the quarter ending November, constituting the three autumnal months, was 50°·2, being 0°·9 above the average of 87 years.

The Weather during the Quarter ending December 31st, 1858.

1858. Months.	Temperature of Air. Mean.	Air. Diff. from average of 87 years.	Air. Diff. from average of 17 years.	Evaporation. Mean.	Evaporation. Diff. from average of 17 years.	Dew Point. Mean.	Dew Point. Diff. from average of 17 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 17 years.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 17 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour. Diff. from average of 17 years.
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	gr.
October ..	50·8	+1·5	+1·3	48·5	+0·4	46·1	+0·3	16·0	+1·4	·313	+·003	3·6	+0·1
November	39·6	−2·9	−4·2	37·9	−4·4	35·7	−4·8	12·5	+1·1	·209	−·051	2·4	−0·5
December	41·0	+2·1	+0·5	39·6	+0·6	37·8	+0·6	8·5	−1·1	·227	−·002	2·6	−0·0
Mean ..	43·8	+0·2	−0·8	42·0	−1·1	39·9	−1·3	12·3	+0·5	·250	+·017	2·9	−0·1

1858. Months.	Degree of Humidity. Mean.	Degree of Humidity. Diff. from average of 17 years.	Reading of Barometer. Mean.	Reading of Barometer. Diff. from average of 17 years.	Weight of a Cubic Foot of Air. Mean.	Weight of a Cubic Foot of Air. Diff. from average of 17 years.	Rain. Amount.	Rain. Diff. from average of 40 years.	Daily Horizontal movement of the Air.	Reading of Thermometer on Grass. Number of Nights it was 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.				°	°
October ..	85	−1	29·834	+·152	541	+2	1·2	−1·6	106	3	14	14	27·0	48·2
November	86	−2	29·750	−·006	552	+5	0·4	−2·2	67	16	10	4	13·0	43·0
December	89	+1	29·771	−·065	551	−1	1·5	−0·7	109	8	22	1	24·0	42·5
Mean ..	87	−1	29·785	+·027	548	+2	Sum 3·1	Sum −4·5	Mean 94	Sum 27	Sum 46	Sum 19	Lowest 13·0	Highest 48·2

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

STATE OF THE PUBLIC HEALTH.

1*st Quarter.*—157,449 births and 98,260 deaths were registered; consequently the natural increase of the population in the 92 days was 59,189, or 643 daily in England. The probable natural increase of population in the United Kingdom was 964 daily. The mortality was at the rate of 1·994 per cent. annually, or ·146 below the average. The average rate of the season exceeds 21; the actual rate of this quarter was less than 20 in 1000. The reduced mortality is, no doubt, to some extent due to sanitary improvements. During the summer the annual rate of mortality in the population of the country, of villages and small towns, was at the rate of 17 in 1000, the average rate being 18; and in the same time the town population died off at the annual rate of 24 in 1000, the average being 26. If the mortality had been at the standard rate, deduced from sixty-three of the least unhealthy districts, the deaths would have amounted to 73,088 instead of 98,260; consequently the deaths in excess of the comparatively healthy average, or the unnatural deaths, amounted to 25,172; of which 20,146 happened in the large towns, and 5026 in the small towns and villages. Diphtheria, often called "throat disease," and typhoid fever have been prevalent in some districts.

2*nd Quarter.*—158,007 births and 118,663 deaths were registered, so that the natural increase of the population in England was 39,344, or 428 souls daily. The probable natural increase of population of the United Kingdom was 642 daily. The mortality was at the annual rate of 2·402 per cent., or rather more than 24 in 1000. The mortality of the quarter in town districts was at the rate of 28 in 1000 living; in country districts at the rate of 21 in 1000 living. Upon taking the four quarters, of which the returns are now complete, the result is that the deaths of 450,018 persons were registered in the year 1858, and the annual mortality was at the rate of 23 in 1000; in town districts the annual rate was 25 or more; in country districts 21 in 1000 died. At the rates of comparatively healthy districts, the deaths in the year should not have exceeded 321,009; the actual deaths amounted to 450,018. This excess of 129,009 deaths is due chiefly to the fatal neglect of the sanitary arrangements which are required in every district, and are indispensable in densely-peopled cities. These 129,009 deaths may be called unnatural deaths, of which about 83,431 happened in the large town districts, and 45,578 in the rest of the kingdom. This is a sad reckoning; but it is an under-statement of the facts.

THE PRICE OF PROVISIONS.

1*st Quarter*.—The price of wheat fell progressively from 72*s*. 3*d*. a quarter, in the months of July, August, and September, 1856, to 59*s*. 11*d*. in 1857, and to 44*s*. 7*d*. on an average in the corresponding three months of 1858; the decrease of price being thus 38 per cent. The price of beef by the carcase at Leadenhall and Newgate Markets fell in the two years from $5\frac{1}{2}$*d*. to $5\frac{1}{4}$*d*. a pound; the price of mutton from 6*d*. to 5*d*$\frac{1}{2}$., or 8 per cent. Potatoes (York Regents) were sold at the waterside market, Southwark, at 78*s*. a ton; or 26 per cent. less than the price of the same season in the previous year. 30 lbs. were sold in 1858 for a shilling; in 1857 only 21 lbs. The price of potatoes was the same as in the corresponding quarter of 1856.

2*nd Quarter*.—The prices of wheat continued to fall in the year 1858. Wheat was sold at 41*s*. 9*d*. a quarter on an average during the last thirteen weeks of the year; and the prices in the thirteen corresponding weeks of 1856 and 1857 were 63*s*. 4*d*., and 52*s*. The fall was 34 per cent. in two years. Beef by the carcase was $5\frac{2}{8}$*d*., $5\frac{3}{8}$*d*., and $5\frac{2}{8}$*d*. per pound in the same seasons at Leadenhall and Newgate Markets; mutton $5\frac{6}{8}$*d*., $5\frac{6}{8}$*d*., and $5\frac{4}{8}$*d*. The average prices of beef were stationary; but the average prices of the higher qualities fell from $6\frac{3}{4}$*d*. to $6\frac{1}{2}$*d*.; the prices of the lower qualities rose from $3\frac{3}{4}$*d*. to 4*d*. Again, the price of the best mutton by the carcase was $6\frac{3}{4}$*d*. at the beginning and the end of the period; while the price of inferior mutton fell a halfpenny in the pound. Potatoes, which are so important an article of food, were sold at the rate of 100*s*., 140*s*., and 87*s*. 6*d*. a ton at the waterside market, Southwark, in the last quarters of the three years 1856–7–8. Potatoes have been 37 per cent. cheaper than they were in the corresponding weeks of 1857, and 12 per cent. cheaper than they were in 1856.

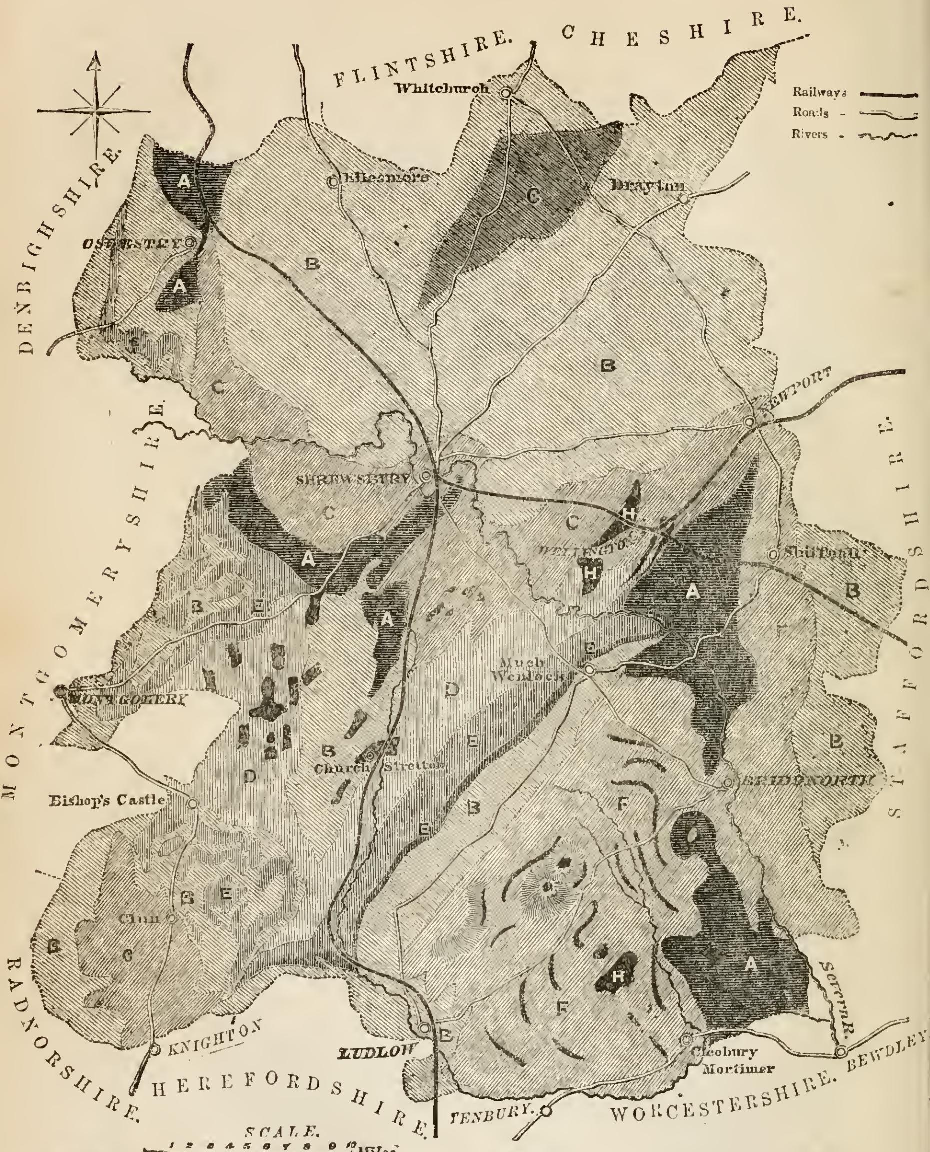
THE PRICE OF PROVISIONS.

The AVERAGE PRICES of Consols, of Wheat, Meat, and Potatoes; also the AVERAGE QUANTITY of Wheat sold and imported weekly, in each of the Nine Quarters ending December 31st, 1858.

Quarters ending	Average Price of Consols (for Money).	Average Price of Wheat per Quarter in England and Wales.	Wheat sold in the 290 Cities and Towns in England and Wales making Returns.*	Wheat and Wheat Flour entered for Home Consumption at Chief Ports of Great Britain.*	Average Prices of: Meat per lb. at Leadenhall and Newgate Markets (by the Carcase).		Average Prices of: Potatoes (York Regents) per Ton at Waterside Market, Southwark.
			Average number of Quarters weekly.		Beef.	Mutton.	
	£.	s. d.					
1856 Dec. 31	$92\frac{6}{8}$	63 4	112,909	103,328	$3\frac{3}{4}d.$—$6\frac{3}{4}d.$ Mean $5\frac{1}{4}d.$	$4\frac{3}{4}d.$—$6\frac{3}{4}d.$ Mean $5\frac{3}{4}d.$	90s.—110s. Mean 100s.
1857 Mar. 31	$93\frac{4}{8}$	56 10	102,433	51,310	$4\frac{1}{2}d.$—$6\frac{3}{4}d.$ Mean $5\frac{3}{4}d.$	$5\frac{1}{4}d.$—$7\frac{1}{4}d.$ Mean $6\frac{1}{4}d.$	100s.—120s. Mean 110s.
June 30	$93\frac{3}{8}$	56 9	107,850	42,178	$4\frac{1}{4}d.$—$6\frac{1}{2}d.$ Mean $5\frac{5}{8}d.$	$4\frac{3}{4}d.$—$6\frac{3}{4}d.$ Mean $5\frac{3}{4}d.$	105s.—150s. Mean 127s.6d.
Sept. 30	$90\frac{7}{8}$	59 11	92,156	55,384	$4\frac{1}{4}d.$—$6\frac{1}{2}d.$ Mean $5\frac{3}{8}d.$	$4\frac{1}{2}d.$—$7d.$ Mean $5\frac{3}{4}d.$	95s.—115s. Mean 105s.
Dec. 31	$89\frac{1}{2}$	52 0	101,025	95,587	$4\frac{1}{4}d.$—$6\frac{1}{2}d.$ Mean $5\frac{3}{8}d.$	$4\frac{1}{2}d.$—$7d.$ Mean $5\frac{3}{4}d.$	130s.—150s. Mean 140s.
1858 Mar. 31	$96\frac{1}{8}$	46 5	99,604	64,652	$4\frac{1}{4}d.$—$6\frac{1}{4}d.$ Mean $5\frac{1}{4}d.$	$4\frac{3}{4}d.$—$7d.$ Mean $5\frac{7}{8}d.$	130s.—175s. Mean 152s.6d.
June 30	$97\frac{1}{8}$	44 1	92,955	86,551	$4\frac{1}{4}d.$—$6d.$ Mean $5\frac{1}{8}d.$	$4\frac{1}{2}d.$—$6\frac{1}{2}d.$ Mean $5\frac{1}{2}d.$	140s.—185s. Mean 162s. 6d.
Sept. 30	$96\frac{4}{8}$	44 7	97,307	82,373	$4\frac{1}{2}d.$—$6\frac{1}{4}d.$ Mean $5\frac{1}{4}d.$	$4\frac{1}{2}d.$—$6\frac{1}{2}d.$ Mean $5\frac{1}{2}d.$	65s.—90s. Mean 77s. 6d.
Dec. 31	$98\frac{1}{4}$	41 9	110,437	54,413	$4d.$—$6\frac{1}{2}d.$ Mean $5\frac{1}{4}d.$	$4\frac{1}{4}d.$—$6\frac{3}{4}d.$ Mean $5\frac{1}{2}d.$	80s.—95s. Mean 87s. 6d.
Col.	1	2	3	4	5	6	7

* NOTE.—The total number of quarters of wheat sold in England and Wales for the 13 weeks ending December 31st, 1856, was 1,467,816; for the 13 weeks ending March 31st, 1857, 1,331,623; for the 13 weeks ending June 30th, 1857, 1,402,051; for the 13 weeks ending September 30th, 1857, 1,198,029; for the 13 weeks ending December 31st, 1857, 1,313,321; for the 13 weeks ending March 31st, 1858, 1,294,855; for the 13 weeks ending June 30th, 1858, 1,208,420; for the 13 weeks ending September 30th, 1858, 1,264,996; and for the 13 weeks ending December 31st, 1858, 1,435,678. The total number of quarters entered for Home Consumption was respectively, 1,446,588 (14 weeks); 667,027; 548,315; 719,992; 1,242,628; 840,475; 1,125,165; 1,070,845; and 707,367.

GEOLOGY OF SHROPSHIRE.



A Coal, &c.

B Ludlow psammite, Aymestry limestone, Ludlow shale.

C Bridgenorth { Sandstone, conglomerate, quartzose, porphyry.

D Silurian. { Caradoc limestones and gritstones, Llandeilo flagstones.

E *Upper Portion, Alstone Moor beds:* Metalliferous limestones, frequent beds of chert, sandstone, ironstone, coal, and culm.
Lower Portion: Dufton scar limestone.

F Upper Killas. { Herefordshire sandstone, cornstone, conglomerate, tilestone.

G Lias. Aberthau blue marl and marlstone.

H Trap in general.

JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

I.—*The Agriculture of Shropshire.* By Henry Tanner.

Prize Report.

This county is replete with interest to the lover of agricultural progress, for it abounds with instances of successful and remunerative farm management. I shall in the following Report endeavour to bring before the reader in a practical way the results of my own observation and experience combined with that of agriculturists of the district. In order that a correct opinion may be formed of the mode of farming, it is necessary to describe the physical character of the county.

The accompanying map shows its general outline to be a parallelogram with a very irregular boundary, and it also shows *the geological formations.* The Llandeilo flags are the lowest beds of the Silurian system, and are 1200 feet in thickness. These are characterised by dark-coloured flags, which are mostly thin calcareous strata, and these alternate with beds of sand, sandstone, and shales. When these rocks crop out they generally produce fertile arable soils. The Caradoc sandstones are exceedingly variable in colour, red, purple, white, and green, amongst which we find conglomerate grits and limestones. The soils are generally of inferior character, unless lime is present either naturally or applied under cultivation. Immediately above these we have the Caradoc flags. These consist of thin beds of a shelly limestone with interlying beds of a green sand. We find here amongst other fossils the Terebratula and some corals. The thickness of these last two beds is 2500 feet, and these complete the Lower Silurian system.

The inferior beds of the Upper Silurian system are distinguished as the Wenlock shale and limestone, and these are 1800 feet in thickness. The shales are argillaceous layers, either of a liver or slate colour, and amongst these we find nodules of limestone. These shales soon crumble under frost or pressure, and produce soils which are generally cold and tenacious, except where they meet with limestone. The Wenlock limestone is a

sound blue or grey stone, valuable as road metal, and when mouldered into soil makes very useful tillage land. We find in these rocks an abundance of fossils, especially corals and crinoidea.

The Ludlow formation is about 2000 feet in thickness, and is composed of the Lower Ludlow rocks, the Aymestry limestone, and Upper Ludlow rocks. The Lower Ludlow rocks consist of a succession of shales similar in colour to the Wenlock shales. These shales are called mudstones in Shropshire. The Aymestry limestones are hard and of the usual grey or blue colour. The Upper Ludlow rocks are chiefly sandstone rocks, with lime and clay occasionally appearing amongst them. The soils upon the Ludlow formation are exceedingly variable. Clays naturally of a retentive character are often laid dry by the peculiar fractures of the rock beneath producing a good natural drainage. Where these soils have not been intermixed with other soils by washing, they are not of high character as arable land.

The Devonian system is exceedingly intermixed in this district; the general order of succession for these rocks is as follows:—Red conglomerates with interlying beds of sandstone, varying in colour from red to green, and in character from sandstones to marls. The soils formed from the decay of these rocks are generally poor hungry sands; but when they get natural supplies of lime and clay they become valuable. After these beds we come upon the cornstones and marls of this system. These are concrete masses of limestones, and with them we have the variegated marls which are of red and green colours. These yield strong but rich and valuable soils. The lowest beds are the tilestones, which, as their name describes, are thin laminated masses, splitting readily into thin flags, and varying in colour from reddish-green to green.

The coal measures of Shropshire are most extensive in the Coalbrook-dale district; we also find them in the plain of Shrewsbury, and in the south-east of the county. Valuable as these beds are in other branches of commercial industry, they generally bear an opposite relation to the agriculturist, as the soils formed upon them are generally poor, heavy, and cold; but we shall have further opportunity of noticing the soils of the county more in detail.

The *Climate* of a district exerts a powerful influence upon the management of land, the crops grown, and the seasons for sowing, as well as the produce; and in order that a person may judge of the suitability of any particular practice to another district, he has not only to know the geological formation and the soil, but also the climate. I am fortunate in being able to lay before the reader the following observations upon the weather, which have been taken with

TABLE No. I.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean of the Year.	Observations taken at	Number of Years.
	°	°	°	°	°	°	°	°	°	°	°	°	°		
Temperature of air, 9 A.M. . .	36·4	37·6	39·9	46·3	52·3	59	61·9	60·6	55·5	48·5	40·8	38·7	48·1	Wrottesley Observatory	10
Mean monthly temperature, day.	41·75	40·75	47·5	55·5	57·25	64·75	69·5	68·75	62·75	56·75	45·5	44·	54·5	Shiffnal	3
,, ,, night	32·75	32·75	33·25	37·	40·25	48·25	52·75	51·	49·	42·75	35·	31·75	41·5	,, ...	3
,, difference . . .	9·	8·	14·25	18·5	17·	16·5	16·75	17·75	13·75	14·	10·5	12·25	13·	,, ...	3
Mean monthly maxima . . .	53·5	51·5	55·5	65·	70·75	75·25	77·5	76·5	69·5	62·	56·25	54·	64·	,, ...	7
,, minima . . .	23·	23·75	24·	29·	31·	40·	45·5	43·	36·5	31·25	24·5	20·25	31·	,, ...	7
,, range	30·5	27·75	31·5	36·	39·75	35·25	32·	33·5	33·	30·75	31·75	33·75	33·	,, ...	7
,, fall of rain . .	2·3	1·26	1·3	1·31	1·52	2·67	3·21	2·32	2·	2·24	2·12	1·79	24·04	,, ...	7
,, ,, . .	1·4	1·	1·11	1·34	1·37	2·14	2·35	2·4	2·02	2·17	1·5	1·38	20·19	Wrottesley Observatory	10
Maximum monthly fall of rain .	2·34	2·44	2·35	2·37	2·44	4·1	3·23	4·44	2·92	3·54	5·65	2·76	. .	,,	10
,, ,, . .	3·9	2·6	3·12	2·	2·18	5·37	5·83	5·94	4·81	3·45	6·59	2·81	. .	Shiffnal	7
Minimum ,, . .	·16	·81	·69	·54	·79	·56	1·03	1·09	1·03	·84	·57	·87	. .	,, ...	7
,, ,, . .	·25	·37	·4	·32	·35	·69	·91	·85	·64	·81	·61	·54	. .	Wrottesley Observatory	10
Barometer	29·38	29·61	29·68	29·7	29·44	29·55	29·58	29·58	29·66	29·63	29·64	29·58	29·6	Shiffnal	3
,, mean maxima . . .	29·78	29·82	29·94	29·84	29·5	29·64	29·6	29·69	29·78	29·74	29·7	29·71	. .	,, ...	3
,, ,, minima . . .	29·25	29·62	29·29	29·52	29·35	29·52	29·5	29·55	29·43	29·53	29·58	29·51	. .	,, ...	3

TABLE No. II.

	1848.	1849.	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	Mean.	Observations taken at
	°	°	°	°	°	°	°	°	°	°	°	
Temperature of the air, 9 A.M.	48·5	47·6	47·6	47·9	48·9	47·1	49·4	47·2	48·4	48·7	48·1	Wrottesley Observatory.
Mean monthly temperature, day	. .	. .	. .	. .	. .	. .	55·5	53·	55·	. .	54·5	Shiffnal.
,, ,, night	. .	. .	. .	. .	. .	. .	42·25	41·	41·25	. .	41·5	,,
,, ,, difference	. .	. .	. .	. .	. .	. .	13·25	12·	13·75	. .	13·	,,
Mean monthly maxima	. .	. .	64·25	64·	65·75	61·25	64·75	62·75	64·75	. .	64·	,,
,, minima	. .	. .	30·	31·5	33·	31·5	31·	30·	30·	. .	31·	,,
,, range	. .	. .	34·25	32·5	32·25	29·75	33·75	32·75	34·75	. .	33·	,,
Mean monthly fall of rain	. .	. .	21·7	22·21	37·58	26·2	17·63	21·13	21·88	. .	24·04	,,
,, ,,	24·18	21·04	15·81	16·08	28·87	22·09	14·53	17·08	20·36	21·88	20·19	Wrottesley Observatory.
,, maxima	3·81	4·66	3·14	2·20	5·65	4·1	2·56	3·54	3·05	4·14	. .	,,
,, ,,	. .	. .	3·75	3·12	6·59	5·37	2·62	5·83	2·77	. .	. .	Shiffnal.
,, minima	. .	. .	·56	·75	·47	·79	·54	·16	·91	. .	. .	,,
,, ,,	·68	·43	·47	·37	·32	·39	·4	·25	·91	·58	. .	Wrottesley Observatory.
Barometer	. .	. .	. .	. .	. .	. .	29·62	29·6	29·59	. .	29·6	Shiffnal.
,,	. .	. .	. .	. .	29·62	29·71	29·8	. .	. .	. .	29·71	Shrewsbury.

Table No. III.

	Spring.	Summer.	Autumn.	Winter.	Year.
	°	°	°	°	°
Mean temperature	51·63	61·66	51·74	40·5	51·
Range of temperature	35·54	36·28	31·72	27·64	32·8
Barometer mean range	1·37	·95	1·02	1·42	2·2
Mean dew-point	46·12	57·89	49·62	40·48	48·53
Difference between dew-point and temperature	5·51	3·77	2·12	·02	2·47

Table No. IV.

Average Direction of the Wind	S.W.			W.			N.W.			N.			N.E.			E.			S.E.			S.		
	1854	1855	1856	1854	1855	1856	1854	1855	1856	1854	1855	1856	1854	1855	1856	1854	1855	1856	1854	1855	1856	1854	1855	1856
January	3	3	5	3	5	2	5	6	9	..	5	..	3	6	5	1	2	..	8	3	9	8	1	1
February	4	1	2	3	1	5	14	4	7	1	3	..	2	7	4	..	5	1	2	6	2	2	1	8
March	6	6	..	4	4	..	6	9	8	2	1	1	3	4	8	1	4	3	5	2	11	4	1	..
April	5	..	5	3	4	1	5	13	7	2	3	1	8	3	6	6	1	1	1	3	7	..	3	2
May	15	4	4	..	2	1	4	6	6	1	9	3	1	4	9	1	2	..	5	3	4	4	1	4
June	6	10	4	3	3	8	7	5	12	..	3	2	8	3	..	1	..	..	2	3	2	3	3	2
July	8	10	8	5	3	4	6	9	10	2	..	..	1	..	1	2	3	1	3	1	2	4	5	5
August	8	6	9	3	5	..	12	7	3	1	2	1	2	2	5	..	..	4	3	4	4	2	5	5
September	12	2	8	2	4	3	7	7	8	1	2	2	1	6	1	..	1	2	7	4	3	..	4	3
October	5	8	5	3	7	1	12	6	4	2	4	..	3	1	4	..	..	4	1	3	10	5	2	3
November	2	1	2	3	..	4	17	9	18	2	4	1	2	4	1	..	3	..	2	2	3	2	7	1
December	3	4	5	14	..	5	12	16	7	1	..	1	..	1	2	..	..	2	..	7	3	1	3	6
Total	77	55	57	46	38	34	107	97	99	15	36	12	31	44	46	12	21	18	39	41	60	35	36	40

with great accuracy and care.* In Table No. I. (p. 3) the climate *of each month* in the year is shown, and the observations are spread over a sufficient length of time to give these averages a considerable degree of certainty; whilst in Table No. II. (p. 4) the climate of *each separate year* is given, which will enable a comparison to be made, showing as it does the limits within which the climate of Shropshire varies. In Table No. III. (p. 5) I have collected some information upon the climate of the different seasons. These observations were taken by Mr. Blunt of Shrewsbury. In Table No. IV. (p. 5) I have shown the prevailing winds, compiled from observations taken by Rev. J. Brooke, of Haughton Hall, Shiffnal. With these data a comparison may be instituted between this county and any other. For information respecting the climates of different districts, the reader is referred to Mr. Whitley's Prize Essay, 'The Climate of the British Islands.' *

The Eastern side of Shropshire possesses a dry and warm climate; but the west and south-western sides are subject to heavy falls of rain and a very moist atmosphere. This is caused by the lofty hills which gather the rain-bearing clouds brought by the west and south-west winds; and these being cooled by contact with the mountainous ridges throw down considerable quantities of rain, and then pass on over the warmer part of the county without depositing much rain. Thus, whilst in the south and western portions, rain is produced chiefly by the hilly nature of the district, on the eastern part it is generally produced by cold winds from the east or north-east piercing the western rain-bearing currents, and thus compelling them to make further deposits of moisture.

The western valleys, owing to their moisture, are also extremely liable to injurious hoar-frosts, and their productiveness is considerably affected by them. The cold of winter is often severe in the west from the winds which come from the Welsh hills. On the east the winters are considerably milder, nor do we here experience at any time of the year such sudden changes in the temperature of the day and night as our more western and southern neighbours have to combat with. This is very important, especially in the seasons of growth. As we shall have occasion to refer from time to time to this subject, I shall at

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* To Lord Wrottesley, Rev. J. Brooke of Haughton Hall, near Shiffnal, Mr. Thomas Blunt of Shrewsbury, and Mr. F. Morton of the Wrottesley Observatory, my best thanks are due, for placing at my disposal the valuable observations I have condensed into the foregoing tables. Wrottesley Observatory is 525 feet above the level of the sea, lat. 52° 37′ 2″, long. 0h. 8m. 49s. W.; the bulb of the thermometer, 4 feet from the ground. The rain-gauge is 22 feet from the ground, and 547 feet above the level of the sea. Shrewsbury is situated lat. 52° 42′ 28″, and long. 2° 44′ 53″ W., and about 300 feet above the level of the sea.

* Journal of the Royal Agricultural Society, vol. ii. p. 1.

once proceed to divide the county into districts and notice each in succession.

In the division of Shropshire into districts it has seemed desirable to group together such tracts of land as possess similarity of character. This, however, in Shropshire is by no means easily done, in consequence of the rapid variations in the soil. It has seemed best to notice it under three districts, which are shown in the accompanying map.

District No. I.

This tract of land is commonly known as the Wheat-land district. It extends over an area of about 120,000 acres, and is inclosed by a line passing through the following places. It commences on its western side at the border of the county, near Tenbury, then passes to Great Cairnham, 2 miles east of Ludlow, 1 mile west of Middleton, thence to Hope, Lower and Upper Hayton, Great Sutton, Stanton Long, 1½ miles east of Monk Hopton to Bourton, and half-way between the latter place and Much Wenlock. This terminates its western boundary. It then takes a south-easterly direction towards Astley Abbot, and passing thence to Morvil we describe a circle around Bridgnorth at a radius of about 3 or 4 miles until we reach Chittor, thence through Chelmarsh to Alverley, and the river Severn completes the boundary to the edge of the county.

The surface is exceedingly undulating in its general character, and from amongst these minor elevations the Clee Hills stand boldly forward at a considerable elevation. There is scarcely any part of the district which is not characterised by this continuous succession of round-topped hills. Numerous valleys are consequently formed, and a great variety of aspect is thus often obtainable even on a small farm. This is often taken advantage of for the purpose of shelter, by judiciously planting belts of wood, and thus some pieces of land are nicely sheltered from cold and severe winds, and are consequently of increased value during inclement weather. The soil generally varies from a strong loam to clay upon a subsoil of marly clay. The quality is seldom good, and as a general rule is scarcely of a medium degree of fertility; but in some parts the soil is of better quality, such as the tract of land stretching across the central portion of the district from west to east at Burwarton, Wrickton, Bould, Botterill Aston, West Cleobury, Middleton, Scriven, and Billingslee, and especially when the land is in close proximity to the Ray Brook, for there we find some very useful grass-land.

To the north and also to the south of this belt of land we have a cold clay of inferior character existing very generally to the extreme limits of the district. Amongst it are many spots of

drier soil, some even becoming gravelly; and so frequently does this happen that the majority of farms have at least a few acres of this dry land. Still the general character of the soil is poor and tenacious and of a low degree of fertility. Much of this tract is rented at from 12*s.* to 15*s.* per acre, whilst other farms will average 25*s.* per acre. The average rental may be considered to be from 18*s.* to 20*s.* per acre, and in many cases dear at the rents paid. As a natural sequence the farmers of this part are not so advanced as in other parts of the county, neither have improvements been carried out here with the spirit which has been manifested in the other districts.

The best farmers in this district manage their land upon the following course of cropping:—Fallow, wheat, clover, Lent corn; fallow, wheat, pulse. *In working their fallows*, the general system differs but little from that generally pursued in other parts of England. Few plough their land as early in the winter as is desirable, and consequently much of the winter is passed before the land is exposed to the action of the sun, frost, and air, besides which the land is seldom ploughed deeper than 4 or 5 inches. Such is too frequently the case, and although there are pleasing exceptions, they are but of rare occurrence. In increasing the depth of the soil, this early winter ploughing is the one by which it should be done; then the winter frosts crumble any adhesive and refractory portions into finer particles, whilst the action of the atmosphere tends to sweeten and purify. Much of the efficacy of the entire process of fallowing depends upon the first ploughing being done early in the season, so as to get the soil *thoroughly* acted upon by the atmospheric agencies. The labour during the following season is much facilitated thereby, for land thus treated will by the early spring have become thoroughly broken up and almost pulverized.

In very many cases I have seen the benefits thus realised entirely destroyed by too much haste in the spring ploughing, that is, from not giving the land full time to become properly dry before it is turned over. It is far better not to plough such land at all in the early spring than to destroy the winter's work by burying the crumbled surface soil, where it is sure to become as soft and greasy as ever. I would rather the horses and men were quite unoccupied, than have them undoing the winter's work by ploughing the land too soon. I therefore strongly urge the great importance of giving the land ample time in the spring before the second ploughing is done. This should never be deeper than the preceding ploughing, for any fresh soil now brought up retains through the summer months its uncongenial character, and detracts proportionately from the benefit of the fallowing.

As soon as the root crop is sown, the labour of the farm is

again directed to the fallows, and by the aid of heavy drags and rollers, the land becomes reduced and well intermixed. If the soil is foul, it is worked into a finer tilth than would otherwise be thought desirable. The endeavour should be to get the soil exposed to the action of the air and sun as perfectly as possible, and yet avoid reducing it into such a pulverized state, that heavy rain would make it run together. This can be very readily accomplished when the land is free from weeds and rubbish, but when the land is foul, it must necessarily be reduced, in order to clear it. Throughout the summer months our proceedings must be regulated by this principle; and by alternately inverting by the aid of the plough, and intermixing the soil by the aid of drags and rollers, we shall store the soil with those elements of fertility which it is capable of secreting within its particles, and which are there jealously retained until required for giving vigour to the growing plant. The argument that fallows are unnecessary is fallacious; *upon certain soils* they are superior to any other mode of management.

Many of the agreements under which land is held in this district require that the land under fallow shall receive *four* ploughings—one before March, and three in May, June, or July; and these ploughings will be sufficient for making a good fallow, provided the land is well dragged (and rolled if desirable) in the mean time. There is a very strong feeling amongst many farmers here against ploughing across the land, and it is therefore usual for the plough always to follow the same line, and for the drags and scuffles, &c., to go across the furrow slice.

I must here again refer to the importance of commencing the fallow—either bare fallows, or for a fallow crop—as soon after harvest as possible. The advantages of autumn cultivation are not sufficiently appreciated in this district; with a peculiarly tenacious soil, in a treacherous climate, the autumn work is the key-stone of success. If the surface can be pared with Bentall's broadshare, and the weeds, &c., burnt and ploughed up early in the winter, the work in the spring will be materially lightened, and the fallowing will be carried out much more *effectively*. Valuable as this time is for bare fallows, it is especially important when a fallow crop is going to be raised; and the peculiarity of the district makes these operations—which are so generally acknowledged to be important—of more than usual influence.

The fallows are generally limed, and frequently dunged also; 100 bushels of lime and 12 cubic yards of dung per acre is the quantity prescribed in most of the agreements, and this is a suitable allowance for such land. The dung is frequently spread on the land before the stubble is ploughed; and this is considered a successful plan, as the dung keeps the land

drier and more open through the winter. Nor is there any danger of waste upon this land, for the soil is quite fitted to retain all the fertilizing matter of the dung; in fact, the dung which is ready in time for being put on the stubble is generally used for this purpose—except when the young seeds come in for a share, which is also an excellent plan—and it may be safely said, that the limited supply of dung is the great cause of its not being more generally adopted. The lime is generally applied after the second ploughing, having been drawn to the field during the frosts of winter and spring, and made into heaps about the field, and intermixed with earth carted from near the hedges. After being spread on the land, it is well intermixed with the soil by the drags, scuffles, and harrows. It should be distributed through the soil as completely as possible, for this is an important point, and materially increases its efficiency in the land. When the lime is simply spread on the land after the dragging and working has been done, and then ploughed under, it is very apt to sink out of the soil, and becomes, practically speaking, lost; whereas, if well mixed with the soil, this is prevented. In addition to this, another inducement to have it thoroughly distributed through the soil is the action which it exerts on the manure previously added to the land. The dung is thus more completely decomposed, consequently becomes more readily incorporated with the soil, and of more value in promoting vegetable growth.

The use of lime is certainly not so extensive as it was, and many employ guano as a substitute, and the experience of those who have done so is very strong in favour of the same results being gained. Can it be that the experience of these true men of practice is another instance of practice anticipating the discoveries of science, and thereby adding some additional confirmation to the opinions expressed, and the suggestions given, by Professor Way, in that valuable Paper on the Influence of Lime on the Absorptive Properties of the Soil?* In that investigation, two important results were arrived at: "That soils and subsoils, even long before the reach of ordinary farm operations, always contain a very sensible quantity of ammonia. In some cases, the quantity present is very many times more than would be added in a very heavy dressing of guano, or other ammoniacal manure. The second result which is exhibited by these experiments is *that the action of lime* in the presence of water *is to set free from the soil*, as nearly as possible, *one half of the ammonia*." It is also worthy of observation, that the extent to which soils possess the power of absorbing ammonia from the atmosphere, is far beyond our

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* Journal of the Royal Agricultural Society, vol. xv. p. 512.

previous ideas on the subject. The same investigation gives examples: "Take for instance soil No. 17 (soil of the London clay, from between Farnham and Guildford, 3½ feet below the surface), and No. 15 (the surface soil above No. 17), and we find, that in either case, ammonia to the extent of three tons per acre, equal to 20 tons of guano, would be absorbed before the power to absorb it ceased. But a further suggestion is conveyed by the result of these experiments; lime is capable of liberating one half of the ammonia contained in a soil. Is it now possible that for profitable agricultural use the ammonia of the soil is too tightly locked up in it?" "Lime may be the remedy at the command of the farmer—his means of rendering immediately available stores of wealth, which can otherwise only slowly be brought into use." It would therefore appear, that the lime acted as a liberator of the ammonia of the soil, and therefore is an equivalent for the use of an ammoniacal manure. The evidence of this district is very decided, that they may be considered as substitutes; and I believe these opinions may be explained on the principles named above. Successful practice does not contradict the laws of science, but shows a degree of harmony of which we become more fully cognizant, as our knowledge of the laws of nature increases.

The process of fallowing having been completed, the fields are thrown up into narrow ridges, and are then ready for receiving the autumn corn. The width is generally regulated by the width of the implements used, the object being to keep the horses in the furrows, and thus they do not tread the lands between. This is very desirable, as the land is thus rendered sufficiently firm for the wheat to thrive, without having those impervious cups which the horses' feet so generally leave on strong land.

Fallow crops.—A portion of the land under fallow is devoted to the growth of fallow crops; these may be vetches, rape, or roots. The growth of vetches and rape is seldom attempted; in some few instances they have been tried, and when the land has been properly prepared they have succeeded. These are crops peculiarly desirable for this district, because they can be consumed on the land *without injury to the ground* or the stock. I should not advise their growth on the poorest portions of the district, but they may certainly be grown on the intermediate quality land. The spring vetch is decidedly the best variety for this part; the most successful mode of growth is to clean the land in the autumn, and having laid on some dung, to plough it rough for the winter. If vetches are to be grown, there must be sufficient condition in the land to ensure *a good crop;* and if the field requires it, dung or some equivalent must be given to it. A good crop of vetches will smother weeds, but

a poor crop is sure to allow rubbish to grow, and thereby the land suffers more than is gained by the crop. A bare fallow is always to be preferred to a bad crop of vetches. With a proper preparatory tillage we thus secure many of the advantages of the bare fallow, but we also add a considerable quantity of vegetable and animal manure to the land which it would not otherwise have had, and the land will still be in excellent condition for wheat, as there is ample time for cleaning the land, after the vetches have been consumed, before the time comes for sowing the wheat. There is another decided advantage gained by the growth of vetches, as more stock can be kept *throughout the year*, and they yield valuable food for fattening sheep.

Rape occupies a very similar position, and offers the advantage of being cultivated with more certainty, and giving a good change of food. Here, as in the case of the vetch, it will be found more advantageous to cultivate 1 acre well than 3 acres badly. The extent sown must depend upon the strength which is at the farmer's disposal; but the chief point must be to cultivate only as much as can be done *well*. For this purpose it should be ploughed up before winter and freely exposed to the air, and in the spring, work it as if for turnips, and then drill it 20 inches wide with artificial manure—say 2 cwt. of guano and 2 cwt. of superphosphate of lime per acre. This should be done at intervals, commencing early in May and ending with the first week in June. When the crop is well out in rough leaf it should be singled out 8 inches apart, and well horse-hoed. The horse-hoeing should be continued at frequent intervals, and the result will be a luxuriant crop of rape, which may be commenced feeding by the middle of August or early in September.

The land may thus be cleaned, and heavy crops matured ready for being fed by sheep on the land, at a time of the year when the greatest advantage is to be realized, and when especially wanted for finishing off the fattening wethers and culled ewes. The advantage of being able to feed a crop *on the land*, not only without injury, but with positive advantage, must be duly considered; the labour of drawing away the crop and bringing back the manure being thus saved, the horses can be put to more profitable employment. To attempt, as a general rule, to fatten sheep (upon land of this nature) during the winter and spring months, can only result in disappointment and loss. There are drier spots which form an exception to this rule, but I refer especially to the heavy and tenacious soils which abound here. On these soils the summer and autumn are the only seasons in which sheep can be advantageously fattened; any artificial food now given will make a good return, whilst its consumption in the wet seasons cannot fail to be unprofitable. The climate in the

spring will have considerable influence in extending or lessening the growth of these crops; to be done successfully it is necessary to be able to turn in a full force; not commencing too soon, and thus injuring the winter's pulverization of the land, but immediately the fitting moment arrives to be able to concentrate more than an ordinary strength. This is no insurmountable objection, for, as we shall see subsequently, the circumstances of the neighbourhood allow it to be done.

The Culture of Root Crops.—At the present time probably one-third of the fallow ground is devoted to the growth of roots. A larger proportion has been grown than is now done, but this increase of growth has not been found desirable under present circumstances. The tillage is commenced as if for bare fallowing, but the dryest and cleanest land is selected for roots, whilst the heavy and foul pieces are left for fallow. Land selected for roots would, as a general rule, be ploughed before the fallow land, and also receive more prompt attention in the spring. The land having been cleaned in the dry weather of March and April, as opportunity may offer, is prepared for swedes as near the middle of May as possible. We do not find as much farmyard manure used for swedes as is desirable. Some draw it on the land, and plough it in before winter, whilst others adopt the plan of spreading it on the land after the working is finished, and then throw the land into ridges from 20 to 30 inches wide. When no dung is used, 3 cwt. guano is generally substituted, and this is sown broadcast mixed with an equal weight of salt just before the land is ridged up. During the last season, in consequence of the scarcity of guano, considerable quantities of superphosphate of lime were used, and it was found to answer very well; but a mixture is found to be better than either alone. By sowing the guano broadcast they avoid any injury to the seed from its caustic character; and by drilling the superphosphate with some ashes the young plant is pushed rapidly into rough leaf. I observe that salt is almost always used with guano in equal quantities, and it is always mixed for a few days before using. It is not used with any idea of fixing the ammonia, as has frequently been done, but simply because the humid character of the salt gives a density to the guano, and thus prevents much being blown away when sown broadcast; and besides this its moisture favours its subsequent action in the soil. Some farmers, in addition to the 3 cwt. guano, use also 3 cwt. of superphosphate: this, however, is quite exceptional. When the field has had dung, one half the usual quantity of artificial manure would be used. The usual time to commence sowing swedes is the 14th of May, and all should be sown by June 1st. It is a common saying that "None beat their first days' sowing

of swedes." Turnips may be sown up to the end of June. In some few cases turnips and rape are mixed and sown early in May, and thus come in for early autumn feed, and the land is clean for corn sowing before it becomes wet. The Skirvings swede is most largely cultivated, and for this district is considered the hardiest root and the best cropper. On some of the better portions the Ashcroft swede comes more into favour. The red and green rounds are much liked as hardy turnips, the former more particularly.

Mangold-wurtzel is grown, but only to a very small extent; neither do carrots nor parsnips receive much attention. They can, however, be grown successfully on the better soil, and in spring are very useful as a change of food for the stock. One great cause of the small growth of mangold-wurtzel is the difficulty of preparing the land for receiving the seed in proper time. This may be obviated by another system, which, although well known and extensively practised in other parts, is not adopted here, and yet I know of no district better adapted for it. The land having been cleaned after harvest, as already described, should be ploughed and then ridged up, say 27-inch ridges, the manure spread in the furrows; the ridges are then split, the ground left rough for the winter. Thus the land lies in ridges all through the winter, and the dung is in the centre of each ridge. No loss arises in this manner from the washing of the manure, for the land is too retentive to allow of it, and the advantage is that the winter frosts crumble and mellow the soil on these ridges, so that we have a fine seed bed earlier in the spring than we can have in any other way, and if the mangold-wurtzel is drilled by hand, the seed can be sown as early as is desirable, and we are comparatively independent of the early spring weather, which is always exceedingly fickle and tedious to the grower of these roots. If the weather is favourable, the ridges may be *shaped* up by having a plough passed down the furrow, but on no consideration should this be done so as to bring up an uncongenial soil. This is easily corrected after the mangolds are up and growing, for a little additional work with the stirrers between the rows will loosen the soil and work it into good condition. The globe mangold-wurtzel is best suited for this district, and is generally selected.

On the dry land the turnips are fed in the field, but in other cases they have to be drawn home. A vast amount of labour is thus involved, and considerable damage done to the land. Few manage to get the roots off the ground soon enough, and consequently the land is sadly pressed by the horses and carts, often destroying the advantages of the summer's tillage. This has led many to lessen their breadth of roots, and to have

vetches or bare fallow instead. I should decidedly advise the growth of vetches or rape where the root crop is decreased, because the same objection does not apply here. There is no mechanical injury done to the land by the removal, and the land is decidedly enriched by the crop being fed upon the surface at a time of year when there is no injury produced by the treading of sheep.

There is another reason which operates practically, and that is the *absolute* value of the root crop when it has to be transported far. The value of roots as a food must be entirely dependent upon their composition. I subjoin an analysis of the swede-turnip, and to show the contrast I have added an analysis of linseed cake.

	Swede Turnip.	Linseed Cake.
Moisture	89·26	12·44
Oil or fatty matter	0·2	12·79
Flesh-forming principles	1·443	27·28
Heat-giving substances	8·474	41·36
Mineral matter	·623	6·13
	100·000	100·

Now it is evident that in drawing home 10 tons of swedes we draw home 9 tons of water and only 1 ton of food, and hence, if we multiply the cost of roots per ton by 10 we have the expense of the food we are using, for it is on the *solid* matter of the food we must calculate the value, for the water can be added from the pump. A reference to these analyses shows very clearly that the matter when dry is very inferior to linseed cake in point of muscle and fat-producing matter, and my own belief is that their value and relative cost approximate. If such is the case with the swede, with how much more force does it apply to the common turnip. The expense of removal from the ground, and the carting of the manure back again to the land, becomes a matter for serious consideration *on the heavy land of this district.* In many instances the growth of root crops appears to have been carried beyond a profitable point. The practice of this district shows a decreasing growth of roots, and if this is met by an increasing breadth of green crops, *which can be consumed on the land*, then the latter will more than compensate for any loss. This loss of winter food has to be met, or else the system must be modified to meet the change. If a substitute can be found in the purchase of artificial food to be consumed with the straw of the farm, then it is clear there is no great difficulty to overcome.

I must not here be understood to advocate an entire cessation from growing turnips, but rather to keep their cultivation within such limits that *the crops can be removed without destroying the benefit of the summer's tillage operations;* for if more food is wanted

for store stock in the winter months, it is better to purchase linseed cake or some other artificial food to give with the straw. My own experience and observation are clearly in favour of using such food for store stock, and I believe more profit is made from using it with store stock than for fatting cattle. This of course presumes that the farmer keeps his stock on an improving system, and not, as is too frequently the case, alternately on good and bad keep, losing under the latter that which had been gained under the former.

Wheat.—This is the chief corn crop of this district, and has given its name to it for many years past. In fact, from 20 to 30 years back wheat was almost the only produce sold in the market. It was an old saying of that time, that "the pigs eat all the peas, the men eat all the pigs, the horses eat all the oats, and there was only wheat left to be sold." In more recent times the spirit of enterprise has found its way here, and a better system of tillage has resulted, whereby a considerable quantity of spring corn and meat finds its way to market as well as wheat. It was then the principal product of the land, and so it is at the present time. It is sometimes sown upon the clover ley, but not often. Nearly all is sown upon fallows, or after a fallow crop removed or consumed early.

The varieties commonly sown are the old red Lammas, Bristol red, Devonshire red, and Spalding wheat, and they are preferred in the order in which they are named. The seed is generally sown broadcast on the fallows, at the rate of 2½ bushels per acre, but on clover leys and pea stubble it is drilled, and then two bushels are sown to the acre. The season commences about the 1st of October, and they endeavour to finish before the month is ended, but the farmers of this sort of land cannot always do as they would. Many dress their wheat with lime, others with blue vitriol, or else with "farmers' friend." I have known it damped and dried again with guano, but this is generally done when sown rather late; great care is taken to keep the horses in the furrows between the lands, so as to avoid treading the land sown, and when the sowing is complete the water-furrows are opened out with an unusual degree of care. This is done to give free exit for surface drainage, and to prevent the water being ponded back, to the injury of the wheat plant in the winter months. The wheat-fields, when finished, generally present a neat and workmanlike appearance.

The crops cannot be said to average above 22 or 24 bushels per acre, and although 30 or 32 bushels may sometimes be met with, it is by no means frequent. The use of a top-dressing of guano and salt, intermixed with a little mould to give it bulk, is decidedly a good plan for assisting the crop; but under any cir-

cumstances large crops are not obtainable, for, although it is called the wheat-land district, it is not situated in a *climate* favourable to the growth of corn. This must necessarily keep the average low, even when the soil and management are otherwise equal to greater returns; for this reason white wheats are seldom sown, being too delicate in their habit. The crops are generally harvested by the aid of Welsh and Irishmen, who come here freely at this season of the year. The Irish always cut the wheat with the sickle, but the Welshmen use the broad hook, and bag the wheat: the latter plan is generally preferred because straw is scarce. Considerable advantage would result from the adoption of a mode practised in the south-west parts of England for facilitating the harvesting of the corn; for, like the counties of Cornwall and Devon, the harvest weather is often treacherous. The plan consists in making a number of small stacks about the field as soon as the corn is cut: each stack is commenced by placing three or four sheaves upright in the centre, and then laying sheaves around them, so as to make the width of the bottom of the heap about twice the length of a sheaf, and from the bottom upwards it is gradually diminished in width so as to make it into a conical heap. It is made secure by some straight straw tied at the top, and opened out so as to turn the rain off from the centre. These can be stacked at 1*s.* per acre, and if the weather sets in wet, the corn is safe; should it prove dry, the warm air passes through the stack and prepares it for carrying. In this manner corn cut dry may be saved in very wet seasons without loss and injury. One-half of the wheat stubble is devoted to the growth of clover, and the remainder to peas and beans.

Peas and Beans are looked upon with some degree of uncertainty, as they are particularly subject to a blight, which is either induced or favoured by the climate of the district, and thus the vitality of the blossom is destroyed. Of the two crops peas are most frequently successful, and therefore most frequently grown: they are generally sown upon a corn stubble, which has had some lime brushed in. The Early White-eye pea is generally sown at the rate of three bushels per acre, and produces in a favourable season about 30 bushels per acre. It is rather a singular circumstance that although both peas and beans are liable to blight, especially the beans, yet when sown together they suffer much less than when sown separate. This practice is, therefore, frequently adopted in *other* equally unfavourable districts, and I should expect would succeed here as well as there: when this is done it is particularly desirable to select varieties which are ready for cutting at the same time. The other portion of the wheat stubble is devoted to the growth of clover.

Clover.—The land is generally laid down in clover with the wheat crop. It is then (or should be) clean and in good condition, in consequence of the fallowing of the land, and hence well prepared for receiving the clover. Only one-half of the wheat is sown with clover, as the land becomes tired of it if repeated more frequently, and the result is a failure in plant: it is thus only repeated once in seven or eight years, which is found quite frequent enough. Generally 10 lbs. or 14 lbs. of clover are sown with the rye-grass, sometimes white, and sometimes red, and occasionally both mixed together: some of the agreements bind the tenants to sow one peck of rye-grass and 16 lbs. of either red or white clover per acre, and in some few cases trefoil is added. There is certainly room for improvement in the clover-leys of this district, as they are seldom good; they may be very much improved by *a judicious mixture of seeds*, and the following have been recommended,* and, from my own experience of their value, I can advise their use.

	For one Year's Hay.	For one Year's Hay and one Year's Pasture.	For one Year's Hay and two Years' Pasture.
	lbs.	lbs.	lbs.
Lolium Italicum	9	9	9
,, perenne	18	18	18
Dactylis glomerata	..	2	2
Phleum pratense	1	2	2
Medicago lupulina	..	1	1
Trifolium hybridum ..	1	2	2
,, pratense	8	4	2
,, ,, perenne	..	2	4
,, repens	2	4	4

Having received a proper selection of seed of *good quality*, the next care is to see that it is properly sown; the surface must be harrowed so as to break the crust, and form a proper seed-bed, the brush and roller following the seed-barrow will complete the operation. Care must be taken to avoid a windy day, and also to protect the seeds after sowing from birds, &c. The seeds may be *lightly* fed after harvest, and *well* rolled down before winter. It is an excellent plan to manure the young seeds with farmyard dung in the autumn; it affords them shelter and nourishment, which is exceedingly valuable, and the benefit is fully shown in the following spring. Any compost matter comes in especially useful for this purpose, and will tend materially to overcome the risk of the plant not standing the winter. The clover-ley is one

* Morton's 'Encyclopædia of Agriculture,' vol. i. p. 1000.

of the most important crops to be secured for the profitable management of this description of land; it affords the opportunity of improving the quality and condition of the land with but little expense. When the crop is consumed on the land, and artificial food given to the sheep with it, the expense of the food is repaid by the stock, and the land is left in better condition.

The clover crop may well be considered the sheet-anchor for the farmer of this district, and much still remains to be done to manage this crop as it should be. Many farmers do apply dung to their seeds, and they certainly excel their neighbours in consequence: nor is the benefit confined to the clover crop, for a luxuriant growth above-ground entails an equally free development below, and thus the ground becomes stored with a mass of vegetable matter which decays and gives good support to the succeeding corn crops. When the seeds hold firm, the land is often left unploughed for two years, and the pasturage continues good, as the climate is favourable for the growth of herbage. Sheep and young stock are often kept upon the clover-ley during the early winter months, and have turnips or other food drawn to them; the ley is then broken for oats: and this brings me to notice—

Spring Corn.—*Oats* are generally sown upon a clover ley, for which purpose it is ploughed in the winter, which allows the turf time to decay, whilst the soil also becomes sweetened and prepared to give the oat a good seed-bed. The oats are sown as early in February as the weather will allow; for early sowing is considered especially desirable upon these soils, which are naturally slow in perfecting their crops. It is also very general to sow oats after roots; and here also the early sowing is desirable. About 4 bushels is the usual quantity of seed which is sown, and this is generally done broadcast. The drill is occasionally used, but is by no means general. The chief advantage in sowing broadcast is the greater breadth which can be sown when the land is ready. Much as one may desire to see improvements in agriculture extended, and the drill superseding the primitive mode of sowing broadcast, yet when the climate and soil are both very treacherous and uncertain, *speed* becomes an object of considerable importance, and hence the broadcast keeps the lead, and will continue to do so unless in exceptional cases. The land here is often scarcely ready for sowing before the weather changes and rain falls. In sowing broadcast it can generally be sown two or three days earlier than it can be drilled; and it often happens that this very time decides whether the field shall be sown in good time broadcast, or wait for drilling and have a late sowing. I am well aware that this will be condemned by many advocates of agricul-

tural progress, but I am convinced of its *practical* importance: and this is the truest standard. The general use of the drill for spring corn would prevent one-half of the present breadth being sown in good time, and would considerably diminish the produce per acre. The Poland oat is very generally grown; and, after a clover ley, I consider 30 to 35 bushels the average produce, but after roots it may be calculated at from 35 to 40 bushels. When oats have been grown on clover ley the land is generally fallowed afterwards; but when sown after roots it would be seeded out.

Spring Wheat is not generally grown except upon the best land; and these instances are by no means frequent. As a rule, the oat is the more profitable crop, and better suited to the soil and climate. The red Russian wheat appears to answer best. The seeds grown under spring wheat are decidedly superior to those sown with barley or oats.

Barley is grown much more freely than spring wheat, but is far from being so general as oats. The drier and best portions alone are suitable for its growth. The "Early" barley is the general favourite. The Chevalier is sometimes grown, but is not so well liked. The barley requires very early sowing; it is often done with success in January and February; the sooner the land will allow it to be sown after the beginning of February, the better is the prospect of a crop. The quality is not of first-class character; and although one-half may be sold for malting, yet the maltsters are shy buyers when they know the district producing it. It is but just to say that this opinion is rather decreasing; and whether it is based upon any difference in the composition of the grain I am not able to determine; but possibly this barley may have superior feeding qualities, and hence would be of less proportionate value for malting. When such a general opinion pervades a class of men it is scarcely fair to consider it only prejudice. It is certain that this is not a description of soil especially favourable for the growth of barley, and hence it is probable that the produce has higher nutritive than malting properties. The average produce may be taken at about 30 bushels per acre.

The Management of Grass-Land now claims our notice. In this district probably 40,000 acres are under grass, and certainly are not managed as advantageously as they might be. If the climate here is unfavourable to corn crops, it is in the same degree favourable for the growth of grass. The chief employment of the grass-land is for dairy purposes, for which the locality offers many inducements. The quality of the grass is, with few exceptions, scarcely good enough to graze bullocks for the butcher, and, therefore, it cannot be better employed than for dairy pur-

poses and the rearing of stock. In common with pasture-land in other parts of England, we find neglect very generally manifest in the management of grass-land. In short, it can scarcely be said to have any management, for the feeding of the grass and making some hay embodies nearly all that is done. Weeds and swamps abound where care and good oversight would soon remove them. I am convinced that a better management of the grass-land of this district will be eminently conducive to local prosperity, and there are no opportunities on the tillage-land of obtaining equally remunerative returns. Nature is here ready to co-operate, and this is a *valuable* help to the farmer. Neglect is the evil to be removed, and attention will soon correct many of the worst faults.

To clear the land from weeds and an excess of water will be a matter of little difficulty when their removal is resolved upon. Unlike tillage land, we can correct these evils in our pastures with far less trouble. Many of these weeds are encouraged by, and depend upon this excess of water for their very existence, and hence a few drains will often correct the evil. As to the remainder of the weeds, the judicious use of the scythe, combined with proper feeding, will soon remove them and prevent further trouble.

The next point to the keeping of the grass-land dry—both by drains and *ditches*—and free from weeds, is the use of manure. The use of farmyard dung is in the majority of cases quite impossible, as the tillage land claims all that can be made; but still it must be remembered that grass-land is exceedingly benefited by its use. We have, however, artificial manures which, although not equal to the dung-heap, are valuable substitutes and assistants. From a very extensive use of superphosphate of lime, I can speak with much confidence as to its value in encouraging the growth of the clovers and finer-quality grasses. Guano used alone brings a strong growth, but it has not the *quality* which follows the use of superphosphate. The best mode is to employ them mixed together, and then we secure both quantity and quality. An application of 1 cwt. of guano and 2 cwt. superphosphate per acre will have a striking effect upon the crop.

Bones have long been used in our dairy districts, but I consider the use of superphosphate a great improvement, because you get greater advantages with less expenditure. Take, for instance, two pieces of land to be manured with bones and superphosphate respectively. Probably the bones would cost 8*l.* or 10*l.* per acre, and would scarcely act until the second year; subsequently they would produce very satisfactory and remunerative results. The superphosphate, however, acts immediately,

especially if mixed with guano. Supposing 2 cwt. of superphosphate and 1 cwt. of guano applied at the cost of 2*l.* per acre, we have *an outlay* scarcely exceeding *the interest* which the tenant would fairly expect from the outlay on bones. The increase of produce, however, *repays the outlay* for superphosphate before the end of the second year, and he has improved his pasture, got his capital returned and ready for re-investment, just when the bones are *beginning* to pay. This is very important to a tenant-farmer. He does not want his money to be slowly returning from the soil, but with promptitude, and thus the use of superphosphate especially meets his case. Besides this, many men, who could not invest 8*l.* or 10*l.* per acre for bones, and wait for the return, might spare 2*l.* per acre with the prospect of a quick return, and this is more especially the case where there is no security for a long tenure. The use of farmyard manure will be found valuable for improving the quality of the grass; but, when this cannot be spared, we have in the superphosphate and guano excellent substitutes, which will soon repay the outlay with considerable profits.

These manures will improve and increase the produce; but I must briefly hint at one or two points respecting the use of the produce. In consuming the grass with dairy cows, or any other stock, it is desirable to feed the ground in regular succession. In doing so, rather concentrate the stock, and, having fed down the grass, give it a period for rest and purification, instead of allowing the stock to continue grazing irregularly over the whole ground. This may appear of small importance, but those who have tried both plans can testify to the manifest difference in the produce both as to quantity and quality. Early in the season care must be taken not to graze too closely, but in the autumn it will be improved by close cropping. This concentration of stock becomes even more important as the stock increases in number.

In making hay there is room for great improvement. Much of it is overgrown and tough in its character; this is a sure sign of bad management. The grass should be cut when it is most full of nutriment, and that has been shown to be when it is in blossom. It should not be allowed to stand under pretext of there not being burthen enough, for if so the grass will have passed its best, and much of the goodness of the sap changed into woody matter, giving strength and firmness to the grass at the expense of its fattening and nutritive character. The next point is to be careful that in making it into hay its quality is not lost by this process; this must be done with as little exposure to the sun as possible. The grass, when cut, should be well spread out, if the weather promises to be favourable; but if not

likely to be haymaking weather, let the grass remain in the swathe unmoved. Should the weather continue wet after the cutting, I should simply turn it over with a rake every other day. If, however, the weather promises fair, then the grass may be spread, and this will be done far more effectually by the use of a tedding or haymaking machine, than can possibly be done with the hand. However careful labourers may be—and at the hay season this can only be said of few, because of the inexperienced hands often pressed into the service—there will be locks or tufts of grass remaining unscattered. I firmly believe many stacks are heated or fired from this cause, but this never arises with a good haymaking machine. If only once well distributed, it never becomes so compact again. Whilst this is being done, the labourer may be engaged about other hay in a more advanced stage, or else in bringing out the grass near the hedges and under the trees into more drying parts of the field. This grass is generally more sappy and less easily dried than other parts, and hence should have every chance of drying and being intermixed. An attention to these minutiæ is more especially necessary, when we calculate upon allowing the stack to heat to a sufficient degree without becoming too hot.

After the grass has been exposed to the sun for four or five hours it may then be gathered into rows—say four rakes to a row. The following morning these rows may be opened out over *half* the ground only, and being twice turned with the machine should be gathered, before the dew falls, into rows, and then run into cocks or pooks. The size of these will be regulated by the condition of the hay, and of course increased in proportion as the hay becomes drier. When advanced thus far the hay may be considered safe, except it is an *exceedingly* wet season, for it should never afterwards be out of control. In carrying forward the process of drying, these cocks should be opened out so as to let the air into the centre. If the weather is doubtful these cocks should simply be lightened up so as to air them, and then left as before; and in proportion as the weather is more promising, in the same degree may they be laid open, but under no circumstances should the hay become spread over the ground again. It does not need the sun now, it is the passage of air through the heaps which will make the best hay. Having been treated in this manner, probably at the end of the third day it will be ready for carrying to the stack; but if of strong growth it will not, and must again be collected into cocks, but now they should be three times as large as before. I never think it a loss of labour to have the haycocks, both large and small, made so as to throw off the rain. The showers come often unexpectedly at this season, and many a wet morning follows a fine and hopeful

day. It is therefore better to be guarded, and especially so in such a treacherous climate as that of this district. The larger cocks especially require to be raked down before leaving them. If the weather has been *scorching*, the hay often appears quite dry, whilst there is an excess of sap inside; this arises from the outside becoming dry quickly and keeping the sap in. The best plan in such a case is to allow it to remain two nights and one day in one of the large cocks. This brings it into a regular sweat, and, upon being opened to the sun and air, the hay quickly gives up its moisture, and is ready for being carried. If the precautions already given have been attended to, the hay may be carried so as to come to a good heat in the stack. This heat is essentially necessary to develop the quality of the hay. When the grass is cut in its prime there is more quality in it, and it is disposed to run to greater heat; hence the making of hay is a matter requiring considerable degree of judgment, but, at the same time, any farmer is amply repaid for giving proper attention to it. The point to be aimed at is to get the stack to a sufficient degree of heat, but not an excessive heat. The few hints I have given may guide, but experience alone can make any one successful. I have noticed this at some length, because *there is so much hay spoilt by bad management*, and very little is as good as it might be; yet it is a most important agricultural product though so often disregarded; and a greater difference exists between good hay and that which has been badly managed, than between the qualities of any other agricultural produce: one sample is bright, supple, and full of quality, whilst another is worth little more than straw.

The extent of grass-land in this district may be advantageously increased by laying down some of the poorest, steepest, and most retentive soils. At present they yield scarcely any profit, but if laid down in grass, at any rate the outlay would cease, and under good management they would contribute to the manure of the farm and certainly yield a better return. The conversion into grass-land of some of the inferior tillage-land would be a great boon; but the tenants generally require help in doing so, because there are many expenses which do not bring any return for three or four years. Such lands should be laid down in grass after a bare fallow. Rape may be sown with it, and this should be drilled early in May, and a good selection of grass seeds sown immediately after. This sacrifice of the corn crop will be more than compensated by the superior quality of the pasturage, but many tenants do not approve of the sacrifice, and in such a case a wheat crop is taken instead of the rape. In either case the ground must be well rolled in dry weather before winter to give firmness to the young seeds.

Orchards.—There are many orchards in this district, but very few of them produce much cider, nor is the quality good. There is a too-general neglect in pruning the trees for them ever to produce a good crop of apples. The mossy branches indicate a want of air to circulate amongst them and dry them after the falls of moisture they receive. As a rule one half of the wood in the orchards might be removed with great advantage, due care being taken to leave the fruit-bearing wood. Most of the orchards here are under grass and fed by sheep and pigs. Considerable advantage would result from digging round the trees and giving them some lime or lime compost. In the manufacture of cider the quality is sadly depreciated by bad management, more especially in allowing the fermentation to proceed too far. The cider is not racked *soon enough* after the fermentation commences, and thus the body of the cider is wasted. *Prompt* and *frequent* racking will check the fermentation, and although it may involve some degree of trouble, this ought not to interfere with the proper management of cider. It is a very good plan to have a frame (say 18 inches square) covered with horsehair, and some crushed charcoal spread over it, and then to pass the cider through it. The consequence is, the charcoal lays hold of the fermenting matter which would otherwise go into the fresh barrel, and not only is much trouble saved as regards future rackings, but the strength of the cider is left uninjured. I do not mean that this will supersede the necessity of racking, but it will considerably lessen it.

The Management of Live Stock.—Cattle.—This is the dairy district of Shropshire, and as the production of butter is the chief consideration, we might have anticipated that little attention would be paid to purity of breed. Such is really the case, for we find all kinds of cows kept. An inferior description of Hereford predominates, but we also find Welsh, Lancashire, Longhorns, Short-horns, Ayrshires, and Devon cows. The three last are represented by very degenerate specimens. The Herefords are decidedly the best as regards quality, but this chiefly arises from the better and more abundant supply of them from neighbouring districts. There are some few herds of Herefords of good quality, but they are exceedingly rare. It is not the rule of this district to have well-bred cows, for they would not suit the requirements as well as inferior-bred animals. The cow which will produce most butter at the least cost is the favourite. The great demand from the manufacturing towns around ensures a prompt sale at good prices, and there are many dealers who travel from market to market purchasing all that the farmers send from their dairies, to be conveyed to the manufacturing

towns. I doubt whether any more profitable use could be found for the grass-land of this district. It is eminently suited for a dairy district, and *the great demand* for the produce offers an additional inducement to this branch of husbandry.

As regards the dairy management, I have only to say that the quality is good, and the farmers' wives, with that care and economy for which they are characterised, show a considerable degree of skill and good management in carrying out their share of the dairy duties. Nearly all is sold fresh, the demand being so great, and scarcely any made into salt butter. In some remote situations it is done to a small extent, but the intersection of the county by railways has considerably reduced it. The cheese made is of very inferior character, and only suited for the use of the servants and labourers.

As I have said before, the cows are inferior in quality, but no doubt as milkers they answer a better purpose than higher-bred cows, and I do not see any sufficient reason for taking up a better-bred class. They calve very irregularly—in fact are dropping their calves all through the year. More are probably calved in the spring ready for the fresh grass than at any other time; but this does not depend upon any systematic arrangement, but rather because farmers in the neighbouring district find a demand for their inferior in-calf heifers when the grass is fresh. The use of linseed-cake for dairy cows (when the produce is sold as butter) is exceedingly remunerative, and the use of 2 or 3 lbs., or even more, daily, will pay back the cost with considerable profit. It should be commenced gradually, and then decreased as the cow approaches drying.

In addition to the dairy stock kept, there is a large number of young cattle reared here. These are the calves purchased with or produced from their cows. The quality of these, as might have been anticipated, is by no means good, still they produce useful heifers for the dairy. The calves are soon put upon skimmed milk, and although some add to it linseed gruel, this is not general. The early treatment of the calves is by no means calculated to render their growth rapid; however, by the aid of roots and hay, they gradually become weaned and ready for the grass. During the summer they get a fair supply of grass, and when the autumn comes they are better than would have been expected. Many are taken to the yards and wintered there; but by far the majority are kept on a dry piece of grass-land all the winter, and supplied with some temporary shedding, where they have turnips with hay or straw. This keeps them very hardy, and with all the disadvantages of not being at the homestead they have certainly the benefit of a vigorous health.

These stock are generally calved down when little more than two years old, or else sold, when two-and-a-half years old, to go to better land for fattening.

Upon the present system I have two suggestions to make: I would advise better bulls to be kept, and that the store-stock should have better food. With the excellent opportunities here offered for keeping up the supply of dairy cows, the object of the farmer is clearly to produce as good a bullock at two-and-a-half years old as his circumstances will allow. The influence of a *good* bull would be great. The cows, as I have said, are of inferior class; but if these are crossed with a *first*-class bull, probably better stock will be produced than from much better cows, and the produce will retain the hardy constitution of the cow with the high feeding character of the bull. A *second*-rate bull is not suitable, and its produce will be far inferior to that of a superior animal. All such stock should be allotted to the butcher; for, however tempting the animal may be—and there will be many really beautiful animals,—a second cross will be a failure. Having thus secured a calf calculated to make a good bullock, give it a more generous system of feeding; supply it with linseed gruel, or mucilage from linseed cake when it loses the new milk for skimmed. Some breeders in other counties give to each calf, daily, $\frac{1}{4}$ lb. bean-meal, $\frac{1}{4}$ lb. crushed linseed, and $\frac{1}{4}$ lb. molasses, made into broth, and added to the skimmed milk. When the calf is weaned, it should have, in addition to good grass, $\frac{1}{2}$ lb. of linseed-cake daily; and if this appears to purge, owing to a rapid growth of grass, change the cake for $\frac{1}{2}$ lb. bean-meal. The same extra food should be continued through the winter, and gradually increased to 1 lb. daily, and this allowance continued until two-and-a-half years old, when we may presume the animal will be sold. This will have added about 3*l.* per head to the cost, but the increase of value will be from two to three times this sum; and such stock would be eagerly sought after for fattening, because of their thriving condition and kindly disposition. Not only can this be done with direct profit, but we must remember the benefit resulting from this addition of fertilising matter to the farm. It is poor economy to keep any animal intended for the butcher upon the alternate system of thriving and declining. A steady progress will be found most remunerative.

I must here refer to a valuable herd of Devon cattle kept at Kinlet by the late Mr. Child. These were of very high merit, and excelled any herd in the north of Devon for number and quality combined. Good cows and heifers were selected from West Devon stocks, and these were bred with first-class bulls. The *celebrated* prize-bull (Devon Herd-Book, No. 108),

from which nearly all the best Devons are descended, was purchased by the late Mr. Child, of Kinlet; and it appears that the stock descended from him in Shropshire were as remarkable for their beautiful symmetry and high feeding character as those which remained behind in Devon. It is a sad loss to the county that the herd Mr. Child brought to so high a degree of perfection should have been scattered at his death in 1824. Great judgment was shown in bringing them to excellence, and considerable benefit would have resulted by the continued distribution through this district of stock from this valuable breed. They were eminently suited for the locality, being better milkers than the Herefords, equally naturalized to the climate, and more productive of profit than others which have succeeded them. Their place at Kinlet has been occupied by the Ayrshires, and more recently by the Herefords, but neither have been as remunerative as the Devons were.

Some of the Highland Scots have been tried on the poor hilly grass-lands with success. These thrive when nothing else will, and, when crossed with a Short-horn bull, breed stock of first-class feeding character and of excellent quality. On the poorest and most exposed tracts there is no class of stock which will pay more money, for they will often more than double their value in one year. I have myself known stock costing 6*l.* per head worth at the end of the same year 13*l.* or 14*l.*, and the increase is just as great when they calve down.

Sheep.—This is not much of a sheep district, and only a small number are kept. These are frequently inferior Shropshire Downs, but more generally Welsh ewes. They are generally purchased in the autumn, and lambed down, both the ewes and the lambs being fattened off after. The district is generally unsound for sheep, and hence permanent flocks are seldom kept. The present system is more profitable than a permanent flock would be in this district, even supposing the land to be sound for them.

Pigs.—These animals are very much neglected in this district, which is surprising, as much of the profit of a dairy farm depends upon their proper management. The majority are coarse and of inferior quality, and they are not kept in sufficient order to be remunerative. As regards coarseness in a pig, this should be confined to the sow. In a breeding sow *for a dairy farm*, a moderate degree of coarseness is rather desirable, and with this we should have a disposition to throw large farrows and a good supply of milk: such a sow is sure to be a good breeder and nurse. The boar to be used in this case should be of the very *best quality*—a second-rate is not good enough; and the progeny will be numerous, hardy in their nature, with a disposition for

growth, and an aptitude for fattening, and will probably be as well formed as the boar. Such stock should be fattened and not reserved for breeding purposes. I do not consider that it would be practicable for the pigs bred on these dairy farms to be fattened there, but I should rather advise the old-fashioned plan of keeping them until they are worth 1*l.* each and then letting them be sold. Pigs bred in this manner would meet with an immediate demand. The number bred should not be limited to as many as the whey will keep: it will be found more remunerative to purchase or grow other food for them, and keep a larger stock.

Horses.—These are strong and active, and, generally speaking, well built. Many are bred here, and sold when four or five years old in the manufacturing district. This explains, in a great measure, the unusual horse-strength observed on most farms. Four horses all at length in a plough; five horses in a cart, with perhaps 2 cubic yards of dung; and long useless teams in the waggons, are of frequent occurrence. But this apparent waste of labour is simply to exercise their horses during times when work is not pressing; at other times, when despatch is necessary, we find the teams divided and accelerating the work on the farm to an unusual degree. This is of immense advantage in the early summer and autumn, when there is an excessive pressure of work to be done. The breeding of horses is, therefore, well suited to the district; and when they allow the colts to be four years old before breaking them in for *regular* work, they always pay the most money. They may, with advantage, be brought into work when three years old, but the labour should be light; and after the colt has been worked three or four months it will be desirable to let it run for eight or nine months more, which will add considerably to the value. Good four-year old horses sell for 40*l.* to 50*l.* each, according to quality.

Implements.—These are generally cumbersome and antiquated; but few modern implements have come into general use. Howard's iron ploughs, Sanders' and Williams' harrows, together with turnip and corn drills, are met with, and are daily becoming more general. Many use the old wooden ploughs, more from having them and not wishing to purchase new ones than from any other cause. The cases are very rare of new implements being made on the old plans. New ploughs are generally iron ploughs, which answer uncommonly well and are general favourites. Portable steam threshing-machines are frequent, and most of the corn is threshed in this manner. Carts are seldom used except for such work as drawing dung. They are never used for harvest work, this being entirely done by waggons.

Farm Buildings are generally well and substantially built. The general plan is a square, with the sheds and other buildings

enclosing a central yard, which is often divided into two or more straw-yards. Additional open shedding is generally wanted, for the present sheds are rather cramped, considering the number which are to be wintered; and consequently many of the young store stock are wintered on the grass-land, which would be better running in a good straw-yard, and having turnips there. Many of the yards are defective as regards the preservation of the liquid manure, for although it may not be considered desirable to go to much expense in using it upon the land, yet we are committing a far greater error by neglecting it and allowing it to be wasted. The most valuable use for it is to pump it upon the dung-heaps as they are fermenting, and this may be done at little cost, and will be a great improvement to the dung. The waste of liquid manure is not confined to the fold, but is generally observable around the dung-heaps. *The Management of Dung* generally is too much neglected. It is, however, deeply important to the fertility of a farm, and neglect must sooner or later show itself in the condition of the land. For grass-land or for young clover seeds the dung cannot be too rotten, whilst for the tillage-land it will be better used long and not much fermented. This is easily regulated by the manner in which the dung-heap is made. If it is not required for some time and then wanted in a slightly fermented state, this may be done by *compressing* the heap as much as possible by driving the carts over it, and then cutting back the ends. If, on the other hand, the dung is wanted to be well rotten, it may be made into a heap *lightly* and turned over. If water is near, so that the heap may be moistened after the turning is finished, it will very much improve and promote the fermentation of the dung. The more rotten the dung is required, the more it must be turned and the entrance of air favoured; whilst if the fermentation is to be checked the air must be kept out as much as possible.

Woodlands.—There is a large quantity of land in this district devoted to the growth of underwood. In some cases the land is entirely devoted to its growth, but it is more frequently grown under and amongst plantations of oak. The oak and ash grow very well throughout this district, and there are many woods containing a good stock of thriving timber, especially around Kinlet. Large quantities have been cut and used for ship building, but still much remains. It is very much to be desired that the growth of timber should be restricted to land devoted to its growth, and that its growth in hedges should be discontinued. The growth of trees here is a severe tax upon the tenant, and the landlord does not realize one-tenth of what the tenant loses, though much of this is paid *indirectly* by the landlord, so that

after all he is the greatest loser. The value of the woodlands in this part is—with the exception of the bark produced—regulated by the state of the iron trade; for, as the wood is chiefly disposed of as poles for pit-wood and as cord-wood for charcoal, the demand is necessarily regulated to some degree by the prosperity or depression of this trade. The iron-masters generally purchase the cord-wood and send their own charcoal burners to convert it.

Draining.—This has been very generally practised throughout the district, and with much advantage, but there is a large proportion of land which still needs drainage. Various plans have been adopted; about 15 or 16 years since the land was drained with turf and stone drains, from two to three feet, but more recently the tile and pipe drains have been gradually superseding the more primitive mode. At the same time the depth has been increased to between three and four feet, which is the usual depth. The results from the pipe drainage have been most successful, and the expense has been considerably reduced by their use. Many of the landlords find pipes, and the tenants bury them. This, however, is unsatisfactory, and by far the larger portion of the expense falls upon the tenant, who naturally does it as economically as possible, and hence in too many cases does not do it efficiently. Other proprietors drain the land and charge the occupant 5 or 6 per cent. on the outlay. This is in every way the best plan, for the proprietor makes *a permanent improvement* and receives a return which not only pays the interest, but after a term of years liquidates the outlay also.

District No. II.

This may be distinguished as the district of Corve Dale, as it includes and consists chiefly of this far-famed valley. It is enclosed on the west by a range of limestone hills, extending from Easthope in a south-west direction to Westhope; on the east it is bounded by the Clee Hills and the rising land of District No. I., and on the south it reaches to the borders of the county. A reference to the map will show it to be a narrow but long slip of land varying in width from 1½ to 4 miles, and about 20 miles in length, and containing about 35,000 acres. It is a tract of land possessing much interest on account of its fertility and the general appearance of prosperity which distinguishes it. From the interesting ruins of Ludlow Castle a view is obtained of a considerable portion of Corve Dale. It spreads beneath this venerable castle like a carpet of verdure of the richest character, and the luxuriance of vegetation at once strikes the beholder with the feeling that he is viewing one of the most fertile of our English vales.

The surface is slightly undulating, just sufficient to give variety to the landscape. The Corve brook runs through the Dale, and is joined by the Ony near Ludlow. The soil is chiefly an alluvial deposit of good quality. Around Ludlow this deposit is 6 or 7 feet deep, and throughout the centre of the Dale, along the course of the Corve, it maintains a depth varying from 2 to 8 feet. The more general depth is 3 or 4 feet. As we rise towards the hills which bound the Dale it gradually decreases in depth. It forms a loamy soil, occasionally becoming a stiff loam, especially in the north portion of the Dale. We also find drifts which are gravelly in their nature, as between Onibury and Ludlow, but these are generally narrow portions of no great extent.

The tillage-land is nearly equal in extent to the grass-land, and maintains throughout the district a considerable degree of fertility, and is occupied by a wealthy and prosperous tenantry. Its produce is very much checked by the peculiarity of the climate, which, as I have already stated, is cold and uncongenial, and subject to a succession of *white frosts* late in the spring, which are very unfavourable to vegetation; hence the averages are considerably below the amount which the land is in every other respect calculated to produce. The course of cropping differs in some degree according to the heaviness of the soil.

On Dry Soils.	On Heavier Soils.
Roots.	Fallow or vetches.
Spring corn or wheat.	Wheat.
Seeds, one or two years, alternating with beans.	Seeds or beans.
Wheat.	Wheat.

Fallow.—Although this is occasionally practised on some of the heaviest portions of the Dale, yet it is generally considered unnecessary. A crop of vetches is much more frequently taken, and thus the land gets a bastard fallow instead of a bare fallow.

Vetches.—The land is broken up for this crop in the early part of the winter, and exposed to the action of the wintry weather. There is not, however, sufficient attention given to the autumn cultivation, and valuable time is thus comparatively lost on many farms. It is of the greatest importance that the stubbles should be made as clean as possible before they are ploughed deep for the winter. This is the time when the couch-grass may be *forked* out with the least trouble, and, as a rule, I should have this done before the surface is broken. Often the couch is broken or cut by the use of various implements, thus increasing the difficulty of its removal, and encouraging its growth very much, instead of checking it. Forking will, in the majority of cases, be found the cheapest and most effectual

mode of clearing the land from this, which is one of the most troublesome of weeds.

This being done, the broadshare or paring ploughs will have free and uninterrupted work, and by their aid, with the harrows, the surface should be cleared and the rubbish burnt. This work should be done very shallow, as giving less labour in the dragging. When the surface is clear, and such dung as can be spared applied, the land is ready for the winter's ploughing. With such a preparation as this, little will remain to be done in spring, except to give the land a second ploughing, and then it will be ready for being sown with vetches. These are sown from March to May inclusive, and about three bushels of seed used per acre. The crop is almost always consumed on the land by sheep which are fattening. The land is then in excellent condition for being prepared for wheat, for after it has been ploughed and cleaned so far as may be necessary, it will be ready for receiving the seed wheat.

Rape is cultivated, but not to any great extent, not so much as its merits would justify; and the remarks already made on this subject (page 12) are equally applicable to this district.

Roots.—Mangold-wurtzel and carrots are grown to a small extent only. Their cultivation may be advantageously increased, as they are very valuable for a change of food. Certainly large stores of these roots are not as much required as when the grass-land is deficient, for, with carefully-cultivated and well-stored swedes, there is an ample supply of food up to the time of turning out to grass. As a pleasant change of food, or for cows and ewes after calving and lambing, a moderate supply of the mangold may be desirable, or some carrots for the horses and fatting stock may be very useful, but they must not be looked upon as a standard food. The climate, from being so moist, is decidedly unfavourable to the mangold, and thus the crops are much smaller than those of swedes. This makes them more expensive, and they must be used in moderation.

Swedes.—This is a crop which can be cultivated here with much success. Some good crops are grown, but there is much room for improvement, and they are capable of being very much increased. Autumn cultivation is of much importance for this crop, and affords the best opportunity for cleaning the land at the least expense. The dung is applied in the autumn, and ploughed in when the land is laid up for the winter. About twelve cubic yards per acre is the usual quantity. After the ground has been worked in the spring, the guano is sown broadcast on the land, and then it is thrown into ridges ready for the seed. The use of salt with guano is not so general as in District No. I., and might be practised more extensively

with advantage. About 2 cwt. of guano and 2 cwt. of superphosphate per acre is the usual allowance. The latter is mixed with ashes, and drilled with the seed. Unlike the first district —where the early or May sowings are preferred—here they are afraid to sow earlier than June. The chief crop is sown in the first and second week of June. An earlier sowing renders them liable to the mildew, to which the crops of the neighbourhood are peculiarly subject. The turnip beetle (*Haltica nemorum*) is a sad pest, and destroys many acres of roots. Both, however, are in some measure under our control, but especially the latter. The use of a moderate quantity of superphosphate, *well* intermixed with some good ashes, and then drilled with *double* the ordinary quantity of seed, will scarcely ever fail, provided you sow when the soil is dry. If sown whilst moist the seed germinates, and when it has advanced thus far the weather often proves dry, and the fly devours the entire crop; but when the ground is dry, there the seed remains until the rain falls, and a rapid growth ensues which saves the crop. The contrary is the general opinion, but the most successful practice proves it to be wrong. Many have great fear of working the land so as to allow the moisture to escape. This is a frequent cause of failure, because it is during this period of dry weather that the crops are lost. The moisture in the soil is seldom sufficient to do more than start the seed, and consequently, if dry weather sets in immediately after, there is a severe battle with the turnip beetle. I very much prefer the seed not growing until it gets rain, and the soil having previously got warm, upon receiving the rain, almost induces a hot-bed growth. I believe the crop may be made perfectly safe by these three modifications—the use of a stimulating manure, sowing an additional quantity of seed, and by giving a preference to a dry soil rather than a slightly moist one. I have, in some years, sown over 300 acres of turnips, and my experience confirms this practice.

The control of mildew is much more difficult, for the best cultivation is most sure of its patronage, and especially when the plant is sown early, and rapidly forced into maturity by artificial manures. For this reason the sowing of a large part of the artificial manure broadcast allows it a slower and firmer growth, which continues later in the autumn. Where the manure is all drilled we have an energetic growth, but as the roots spread from the manure, they cease to find equally nourishing food, hence, when much growth has been effected, the vigorous development is checked, whereas if the rootlets, as they spread, found fresh stores of food, the growth would be prolonged. As soon as the circulation becomes languid, and the leaves lose their usual vigour, they become liable to the attack

of these minute fungi. Hence any plan which stimulates the *autumn* growth is calculated to retain an energy in the plant which will defend it, in a great measure, from this disease. I have no doubt that the use of some superphospate and guano, thoroughly intermixed with mould, and sown over the crop about the time of the mildew appearing, would stimulate the growth and save the crop. This disease is a great check to the full development of the swede crop, for every step we take to make the crop superior is one step towards mildew: whether it is heavy manuring or hoeing the plants out so as to give them plenty of room, all tends to render the crop more liable to its attacks.

Early maturity and rapid growth are equally unfavourable for keeping roots for any considerable time. The tissues are less firm than in cases of slow growth, and consequently more liable to decay. As the swede is so well suited to this district, and for spring food is preferable to mangolds as a standard crop, for the reasons before named, it becomes very important to be able to grow and store these roots in the best manner. When especially intended for *late* spring use, the mode of growth should be modified. They should be drilled with only a small quantity of superphosphate, say 1 cwt. per acre; not much manure should be ploughed in, and they may be sown in the third week in June. They should not be hoed out above 8 or 9 inches apart, and our endeavour should be to get a crop of moderate-sized roots rather than a heavy crop of large roots. Of course this special mode of cultivation will be only carried out to a limited extent. I have found the *white swede** well suited for this purpose, as they may be sown in the third or fourth week of June, and keep later in the spring than any other sort.

In storing swedes two plans are adopted, accordingly as they are to be fed on the field or not. In the former case, having marked every 8th or 10th drill and had the swedes in them pulled, a wide furrow is ploughed, into which the swedes, as they are pulled, are regularly stacked with their tops up, and after this is done the plough goes round the rows once or twice and earths up the sides. In this state they will remain for a considerable time, and when they are seen to sprout in the spring, if a few ewes and lambs are turned amongst them they will keep them in check. The great advantage of this plan is the economy of labour in storing the roots, together with the equal distribution of the roots over the field.

When the roots are going to be drawn from the land the usual mode of stacking is adopted. Having selected a dry spot, the first

* Sold by Jeffries, seedsmen, of Cirencester.

roots are stacked into a heap about 6 or 8 feet wide at the base, and tapering off to nothing at 5 feet high. Care is taken to secure them as dry as possible; if the weather is fair they will be better for remaining open for a time, but if not sufficiently fine for this, let them be covered with a layer of straw, then a trench must be made around them and the earth cast upon the heap. The whole may then be thatched down, taking care to place several wisps of straw on the ridge to act as ventilators. For several days after they are stored moisture will be observed at the ends of the heap, which is condensed from the vapour passing off from the roots. The ends should be kept as open as possible to allow of a current of air through the stack, and thus promote the evaporation of the moisture from the fresh roots; but, of course, frosts must be guarded against. If the stacks are made so as to keep in this moisture, *the tendency to decay* is very much increased thereby.

By far the greater portion of the swedes (say three-fourths) is consumed on the land in the southern portion of this district, but as we proceed northwards and the land becomes heavier, so we find more cattle and fewer sheep kept, and consequently a larger proportion is drawn home. As a general rule, when fed on the ground the crops are economically used, and the sheep do very well, the swedes being cut for them and given in troughs. In the spring, just as the days lengthen, they have some oil-cake or corn given to them, and the progress they make is most satisfactory. It is in the spring, when the sun begins to regain power and all nature is prepared to move, that the assistance of artificial food becomes so valuable, for not only will the carcase nearly pay the cost, but the increased value of the fleece will be very evident.

Wheat.—This crop is sometimes sown after a fallow, as on the heaviest land; at other times on a bastard fallow, after vetches or rape, and also after a crop of roots, and on a clover ley. The month of October is the season for sowing, and as much as possible is sown then. The fallows and other clean land are sown broadcast after the land has been well pressed, but on the clover ley, &c., the seed is drilled, and here also the land-presser is used. From 2 bushels to 2½ bushels of seed are sown, the "Old Red Wheat" being considered the most productive variety. White wheats are generally objected to for autumn sowing, and whenever they are sown it is in spring. The more delicate character of this wheat renders it less suitable to the climate of the district. The crop depends very much upon the season; if the spring and early summer has many white frosts (which are so common throughout the Dale) late in the season, the growth is checked, becomes unhealthy, and does not fully recover itself before harvest; in such seasons the crop will vary from 25 to 30

bushels, but in a good season from 30 to 36 bushels. The heaviest crops are thus far below what the quality of the land would lead one to expect, for such land in the east of England would produce from 40 to 48 bushels per acre, but this climate is not favourable for wheat. There is a very strong objection against finishing the land off finely when sown with wheat; the object is rather to leave it as rough as possible,—partly because these clods protect the wheat from the cutting winds which rush up the valley, and also because if the soil is left fine it is disposed to run together, and this causes an unhealthy growth.

Barley of good quality is grown here, and well liked for malt; but here also the crop is small, generally varying from 30 to 35 bushels per acre, in dry seasons only reaching to 40 bushels. It is always sown after roots fed on the ground. March and April are preferred to an earlier time for sowing; and the latest sown, if followed by a favourable season, often grows the most luxuriantly.

Oats are not grown largely, and are generally put on the worst land, especially on that towards the sides of the Dale rising to the hills. I doubt, however, whether, even on the best ground, oats would not pay better than wheat. So few oats are grown in the bottom land that an opinion cannot be confidently expressed; but I have known it proved in some trials that were made. Much of course depends upon season; for in a very good season the wheat might flourish, so as to pay the best, whilst in a bad season the reverse would probably happen. It is, I believe, worthy of more general trial; and in such trials I strongly recommend seed direct from Scotland. The produce of such Scotch seed might be again sown, but *then* fresh seed should be procured. I have found these white oats far more productive than local seed under the same circumstances; for when my average growth was from 27 to 30 bushels, I have had, in the same season, from 37 to 40 bushels, and the only difference was in the seed. The oat is much more hardy than wheat, and more naturalised to *moist* climates; thus, where the wheat cannot grow, the oat will flourish luxuriantly. Of all corn crops this is the least liable to failure, and under improved management promises to be far more profitable than at the present time.

Beans and Peas are not largely grown. When the land is tired of clover, these are substituted; but they are most uncertain crops, and are more subject to blight than even in District No. I.: their cultivation therefore leads to many disappointments.

Seeds.—The remarks already made, when noticing District No. I. (p. 18), are equally applicable to this district. The facts

are the same in both, and the comments apply with equal force to both ; repetition is therefore unnecessary.

Grass-Land.—This is the stronghold of the Corve Dale farmer ; without his grass-land his occupation would be only of small value, but with this he holds a sure source of remuneration. In fact, the prosperity of the farmers of this district depends far more upon their grass than their tillage land. There are probably 20,000 acres under grass in this district, and it is throughout rich grazing land. I must here again refer the reader to District No. I. (p. 20) for many remarks on this subject, which are equally important for this part. I must however draw attention to the importance of giving a preference to grass rather than tillage. It is clear that many difficulties are connected with the growth of corn. The average produce of corn is small, whilst the growth of grass is abundant and of excellent quality. Nature favours the one, but checks the other. Need we then be surprised that the profits should come from the produce of grass-land? It teaches one important lesson, viz., that the decrease of the tillage and the increase of the grazing land will be attended with more profit. A certain portion must necessarily be kept under the plough for the supply of food and litter for winter use ; but if this were the only object in view, there would be a considerable decrease in the extent of tillage land. Let it be remembered which pays most profit, and much will go under turf again, and pay far better than it does at the present time under the plough. The expenditure of the farm is mainly upon the tillage land, whilst the return is chiefly from the grass.

Live Stock.—*Cattle.*—The Hereford cattle are found here in the highest perfection, and very few other breeds are met with in the district. Occasionally a Welsh cow or two may be kept for supplying the house with milk, but the calves are invariably sold or fattened for the butcher as soon as possible. To mention the herds of such men as Mr. Lloyd Roberts of Cofton Hall, Mr. Dawes of Elsidge, Mr. Evan Davis of Patten, Mr. Power of Cofton, Mr. Blockley of Tugford, Mr. Parsons of Tugford, Mr. Blockley of Broadstone, Mr. Instone of Bourton, Mr. Bache of New House, Cofton, is at once evidence of quality of the highest character to any one acquainted with this part of the country. It may be said that the entire district stands unrivalled for the number and quality of Herefords upon the same extent of land.

The system generally adopted is quite in accordance with the excellence of the breed, for the production of a fine bullock is the point constantly aimed at. The cows calve during the months of November, December, January, and February, and the calves are suckled by their own dams. Milk is not the

object here, and the calves get their full share, nothing but *an excess* of milk being ever drawn off. The consequence is, that when May comes, and the grass is ready, the calves are also ready to be weaned; and, having had this good preparation, they thrive on the grass when they are turned out. Shelter and proper care are given to the calves until they are accustomed to the change. The cows, when dry, are turned away to summer on the poorer pastures towards the hills; but if they are not in calf, they are turned upon rich grazing land to fatten. Much of the land will fatten a 45 or 50 score bullock per acre, besides two or three sheep. The calves are summered on good grass-land, and wintered on hay and turnips, and are kept very well from the time of birth until sold to the butcher. Any heifers which may be reserved for breeding purposes are not kept so well the second summer, but, in common with the other stock, they are kept improving, although not so rapidly.

Some few farmers sell their stock when two years old; they are then worth on an average 18*l.* or 20*l.* each; but the majority keep them well through the following winter, and sell them in the spring, when they fetch from 20*l.* to 24*l.* Some keep them until three years old, and then they turn out beautiful beasts, worth 25*l.* to 30*l.* A large proportion of the summer-grazing bullocks are sold at Ludlow Fair (September 28th), where may be seen a collection of beef which, for quality and quantity, will rival any fair in the kingdom. There farmers may be seen selling perhaps 20 fat cows each, the culls of their herds, at 25*l.* to 30*l.* a piece, besides fat steers.

Some extraordinarily fine animals have been reared in this part of Shropshire by crossing Hereford cows with a Short-horn bull, thus giving greater weight and disposition for fattening; but it is not extensively done, for the subsequent produce from this cross-bred stock very rapidly fails in quality, and yields inferior stock. The chief inducement to cross the blood appears to be from the fact that the Herefords have been "casting" their calves *very much* of late years, and the use of a bull of another breed has been found to lessen the loss very considerably. This probably arises from a greater degree of vigour in the embryo than when the same strain of blood is used.

The Herefords, in common with all other improved breeds of cattle, have, by following too closely the same line of descent, become enfeebled as breeding animals, and it is observed that the same circumstances which produce abortion in a well-bred Hereford cow are without effect upon an inferior animal. It is however very singular, that when this enfeebled condition of the breeding powers exists both in a Short-horn and Hereford, although this weakness would produce bad results if they were bred on in

the same line, yet when crossed with each other the weakness is overcome, and a vigorous produce is the result. If, as I believe, a close kindred of blood renders the Herefords of this district susceptible of this influence, it is clear that the introduction of fresh blood will render them less so. This, however, is not *the cause*, for we must draw a line of distinction between the cause which operates, and that peculiar state of the system which renders an animal predisposed to, or susceptible of this prejudicial influence. We may have two cows in the same field, and in every respect under the same treatment, the one a well-bred Hereford, and the other an inferior Welsh cow; the former casts her calf, but the latter is not influenced in the same way. The same cause has operated on both, but whilst the one has not energy to withstand or throw off the irritating agent, the other is able to do so, and thereby escapes its influence.

One of the most frequent causes of abortion is the diseased herbage of our meadows. This is especially the case with rye-grass, which, when it has run to seed, and is subsequently exposed to a moist climate, developes a fungus possessing very similar action to the ergot of rye, though in a much milder form. Professor Buckman, in his account of the Natural History of British Grasses,* states that he has gathered ergot from almost every species of grass, but the rye-grass is especially liable to this disease. In order that the reader may be able to recognise its appearance, the accompanying Plate is extracted from the above-named article. (See p. 41.)

The great extent to which this evil has extended demands the serious attention of all connected with this district. The losses have been most serious throughout the neighbourhood. I know one breeder who lost 1200*l*. in three years from this disease. The land which has been most productive of abortion is that portion which has been grazed; for here the rye-grass has had the opportunity of running to seed, and from this seed the ergot is afterwards produced. It is clear, therefore, that one way to avoid the evil is to remove in-calf heifers and cows from such fields as soon as the hay is carried from the mowing-ground, and keep them on the after-grass, which would probably be quite free from the exciting cause.

I may say that, as a rule, animals of *inferior* quality are held in very low estimation throughout this district, and when animals are grazed which are not bred upon the farm, those of good quality are alone purchased. No doubt this results from the Herefords being such good feeders and grazing so readily. Occasionally we have the Hereford bullocks broken for work,

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* Journal of the Royal Agricultural Society, vol. xv. p. 477.

but the instances are rare. The object of the breeder is to produce *beef* and not labour animals. The large number of horses

Description of the Plate.

Ergot of Rye . *a* Ergot in the chaff-scales.
,, *b* Section of ergot surmounted by the pistils, thus showing it
,, to be a diseased grain.
,, *c* Transverse section of the same.
Rye-Grass . . . *d* Bearing several grains of ergot of different sizes.

kept here renders the employment of bullocks unnecessary, and hence the custom of not working them is no doubt quite correct for this part of the country.

Sheep.—If this district deserves a high degree of credit for its

cattle, such reputation is equally merited by the flocks. Many first-class breeders of Shropshire Down sheep reside in Corve Dale. As the origin of this breed is at the present time a disputed question, I feel bound to refer to it. There are many who claim for the Shropshire Down sheep the position of being *a pure original breed;* others, whilst acknowledging their high value cannot allow them to be a *pure* breed. For my own part I do *not* consider them a pure breed, but a cross-bred animal from the original Longmynd or old Shropshire sheep. Plymley, in his 'General View of the Agriculture of Shropshire,'* published in 1803, says: "There is a breed of sheep on the Longmynd with horns and black faces, that seems an indigenous sort; they are nimble, hardy, and weigh near 10 lbs. per quarter when fatted. Their fleeces upon an average may weigh 2½ lbs., of which ½ lb. will be the breechens or coarse wool, and is sold distinct from the rest. The farmers of the hill country seem to think the greatest advantage they derive from the access of foreign stock is from *the cross of the South Down*, with the Longmynd sheep; the produce they state to be as hardy and to bite as close as the Longmynd sheep, and the weight of the carcase is increased." It is therefore evident, that between fifty and sixty years since this cross of the South Down and the Longmynd sheep was a favourite. That this practice continued cannot be doubted, for it is well known that first-class flocks of *pure South Downs* were kept in Corve Dale, and annual ram sales were held for very many years until they were gradually superseded by the improved Shropshire Down. Up to the present time South Down rams from the best breeders still find their way from the east of England to the county of Shropshire. Even those flock-masters who claim to be holders of the original breed cannot give proof of purity of blood for twenty-five or thirty years. It does however appear to me to be very unimportant, for if not an original breed, it is very certain they are *an established breed*, and that their character and peculiarities can be perpetuated most satisfactorily. In fact the rapidity with which this breed has risen into favour is very strong evidence of the general estimation in which it is held. Only a few years since any mention of the Shropshire Down sheep raised an inquiry even amongst intelligent agriculturists as to their character, and few, comparatively speaking, knew anything of them; now they stand high as general favourites, and they are rapidly extending throughout this and foreign countries. It is almost superfluous to describe the character of this sheep, as it is so well known; but I may briefly state, that the Shropshire Down sheep combines the

* Page 260.

symmetry and quality of the South Down with the weight of the Cotswold; it possesses the fattening tendency of the Leicester without its delicate constitution; but this disposition to fat is combined with such a development of the muscles of the body, that a beautifully marbled meat is produced, which can go on any table in the kingdom, and especially amongst the higher classes of society, where the excessive fatness of the Leicester mutton is objectionable. The price of this mutton is as high as any in the market, and when this is said of sheep ranging from 35 lbs. to 40 lbs. per quarter, and carrying fleeces of the best quality from 6 lbs. to 12 lbs. in weight, it must be admitted that such a breed is indeed of very high value.

Throughout this district the Shropshire Downs are generally kept pure, being considered more useful than any cross-bred animal. A cross from the Leicester gives a greater tendency to fat and a more delicate constitution, less able therefore to withstand the influence of wet and cold. A decreased energy of system results therefrom, and the animal not only does not progress during inclement weather, but is more susceptible of disease. The tendency to produce fat when unaccompanied by a proportionate development of muscle is not desirable with the Shropshire Down, for they now excel all other downs in this valuable point to the connoisseur, by having a well-formed muscular system, giving plenty of lean, and yet interlaid with a moderate proportion of fat. For these reasons, the introduction of Leicester blood is strongly objected to. The Cotswold blood has been tried, but it has not been received with more favour. Scarcely any increase of weight has been gained, but the quality of the Down mutton has deteriorated, and hence more harm has resulted than good. With ordinarily liberal feed the Shropshire hoggets will weigh 20 lbs. per quarter at twelve months old, and at twenty months old they will very often average 35 lbs. per quarter through the lot. For the last three years good hoggets, sold in May, have fetched, with fair management, 41*s.* to 46*s.*, besides cutting 6 lbs. or 7 lbs. of wool each. There is therefore no great advantage to be gained by the increase of weight, and even if there had been, there must be some very strong reason to induce flock-masters to sacrifice the point of quality, which is so jealously guarded in the Down sheep.

In the northern portion of the district the flocks are not permanent, because of the unsoundness of the land. The usual custom here is to purchase Welsh ewes in the autumn, cross them with Leicester rams, and fatten both ewes and lambs. The Welsh ewes have very much improved within a few years, and really useful flocks are now driven into and through this county, from districts whence we only used to have stock of very inferior

quality. The ewes driven over this autumn (1857) sold at 24*s.* to 34*s.* each.

Horses.—The same system is adopted here which I have described as being practised in District No. I., but the horses bred here are larger and better, probably arising from the better pasturage. These horses are very hardy, and the breeders are always desirous of giving them a strong constitution. Horses which are in regular work are kept out at night as long as possible, generally up to December, whilst the younger horses are not taken up until January. A dry piece of grass-land is selected for them, and some hay is given them in racks in the field. When taken into the yards, they scarcely feel the change to dry food. Some do not take them up at all, especially if there is a sheltering-place in the field.

Orchards.—There is but a small extent under orchard, for, although the blossom may promise very luxuriant crops, yet the white frosts injure the productiveness of the trees so much as to check any extensive growth of apples. Most of the apples are crushed by portable steam-machines, which travel the district; and these, with small power, grind 20 hogsheads a-day. This is afterwards pressed by hand. There is much opportunity for improving the cider made here: it has the general fault of being over-worked. Its body is destroyed by long fermentation, and hence it is not half as good as if the fermentation had been properly held under control, as I have already pointed out. The orchards are generally broken and regularly cropped with roots and corn, followed by seeds for one or two years, after which they are broken again for wheat. It is found much better to cultivate orchards in this district, though in District No. I. it is just the reverse.

Draining has been very generally done where it has been found necessary: but there still remains much land which would be greatly improved by it, especially in rendering it more healthy for sheep and cattle. Much has been done with stone drains in the neighbourhood of the gravel drifts before referred to. The working of these soils always brings a large quantity of stone to the surface, which is used for drains, roads, &c. They must not be taken to any great distance, or the expense of carriage exceeds the cost of pipes. By far the greater proportion is done with pipes, without any stones, and they are generally laid three or four feet deep. The northern parts of the Dale have a soil which requires the aid of some artificial drainage, but it gradually gets drier as we proceed southwards. As we ascend the sides of the Dale we find alternating beds of clay and gravel, and here the drains are more wanted than in any other parts. In the majority of cases, by running a deep drain transversely to the slope of the

hill, so as to intercept the water just before it crops out, a large breadth will be laid dry.

Farm Buildings.—The residences and homesteads throughout this district are generally good and convenient, and adapted for the highly respectable class of men who occupy them. The square is here generally adhered to. With few exceptions, they are substantially built, and afford ample accommodation for the requirements of their respective farms. The system of straw-yards with open shedding is general. As there is a large fall of rain in this district, it is desirable to prevent as much as possible injury arising therefrom. The drainage from the yard should be carefully economized; the buildings properly spouted, and the water conveyed away from the dung. The area receiving rain is thus very much decreased, but this desirable object is very generally neglected.

The Fences are generally kept in fair condition, but the ditches require more attention in the early part of the autumn, before the land gets soaked by an impeded drainage. The fields are generally of convenient size. Although this district is not burthened with the *usual* proportion of hedge-row timber, still even here there is decidedly too much. The growth of timber upon land of this quality is a perpetual loss both to landlord and tenant. Timber should be grown upon land solely appropriated to its growth.

Tenure of Land.—Most farms are held under agreements for yearly tenancies, and are restricted as to the course of cultivation and the sale of some of the farm produce, such as fodder, dung, &c. On many estates a regular register is kept, showing the crops and management of every field, and this enables the agent to know in some degree how the land is being managed, and if fairly dealt with. It is certainly a good plan, and no farmer who is managing his farm well need object to it. The question of security naturally arises, and although instances are exceedingly rare of tenants being ejected from their farms, yet to the prudent calculator it is but a fair subject of inquiry. Landlords have many and just objections to grant leases, and there is no doubt that a *bad* lease is very hard upon one party or another. The two years' notice, with restriction as to *excessive* cultivation after notice has been given, appears to me (when combined with a fair scale of allowances) to give the requisite security for all true tenants' improvements. If, however, the tenant has to make *permanent* improvements, this is exceptional, and must be specially stipulated for. The warmest feeling of confidence exists between the landlords and tenantry of this district, and long may it continue.

District No. III.

This is by far the most important of the districts into which I have divided the county. It preserves throughout points of character which render any subdivision of it unnecessary and undesirable.

The south portion of this district is dotted over with a number of hills, such as Hopton Hill, Caer-Caradoc, and many others, which give a great boldness of character to the scenery, and render the land exceedingly irregular and uneven : level ground can scarcely be seen, except along the base of the valleys, which twine amongst the numerous hills. The soil is generally light, often quite sandy, at other times thin, and near the rock ; most of it is poor, and of inferior quality, but along the valleys there is land of good quality. This portion of the district is bounded on the west by the Welsh hills, and on the east by the hills which prolong the Wenlock Edge. From amongst these also many valleys run into the district, and by their superior quality add much to its general fertility.

Proceeding northwards, but still keeping near the Welsh borders, we find in the neighbourhood of Middleton, Wilmington, and Shelve, an inferior yellowish clay soil, yielding only a poor pasturage, but still more unprofitable as tillage land. Around Church Stretton we come again on land of superior quality, and the whole of the valley in which this town is situated is distinguished by the good quality of its pasture land : in the neighbourhood of Woolstaston, Cardington, and around the base of the Lawley Hill, gravelly loams are found occasionally intermixed with sand and clay.

At Shrewsbury we find some land of first-class quality, varying from strong rich loams, to sandy loams of inferior value. Here we meet the river Severn, a river second only to the Thames for importance and length ; it is navigable throughout the entire length (above 60 miles) of its passage through the county, and adds not only to its commercial wealth, but also to its agricultural prosperity. Along the banks we have some beautiful meadows, but the floods to which they are liable very much reduce their value. It is a great loss to the proprietors that they cannot unite for securing the embankments of this river, as has already been done in other cases. Proceeding northwards towards Oswestry we meet with extensive tracts of deep loamy soil, but occasionally we find gravels lying amongst them ; the latter, however, are not of much extent ; marl is often met with in this part. In the neighbourhood of Aston, and between this place and Sandford, peaty land exists, but this

has been made useful by drainage ; between this and Ellesmere these peats are frequent.

At Ellesmere we have a lovely district, with a scenery of almost unparalleled beauty for the midland counties. The extensive lakes, with the rich and varied foliage around them, impart to it the highest degree of romantic beauty. Turning from the ornamental to the useful, we may retrace our steps to the plain of Salop, commonly called the Shrewsbury Land, and this occupies the northern and eastern portion of the county as far south as Coalbrook-dale. Here is, indeed a rich tract of beautiful tillage land, dry and of good quality, and adapted for the production of any description of crop or stock. The surface is a continued succession of gently sloping land, occasionally interrupted by the bold protrusion of rocks, which, with their ragged outlines, give quite an interesting character to the luxuriant vegetation around their bases. Of these the Wrekin is the most important: it rises very abruptly from a comparatively level part of the county to the height of about 1200 feet above the level of the sea, and although not so high as some of the hills near Oswestry, yet from its peculiar situation it is by far the grandest of the Shropshire hills, giving rise to the old Salopian toast, "All friends round the Wrekin." Around the neighbourhood of Hawkstone it becomes almost exclusively a dairy district, and is generally held in small farms, of which the greatest part is grass ; there is a fair proportion of grass-land of good quality near the Tern and Strine, also near the Cherrington and Lee Brooks.

Between Much Wenlock, Sutton, Maddock, and Shiffnal, there is a strong loamy soil upon a marly-clay subsoil. At Kinnersley we meet with a peaty soil, which is frequently found here, although not usually in such large quantities as near the above-named place. The appearance of these boggy soils needs some explanation, occurring as they do with such frequency in various parts of this district. I attribute their formation to springs rising from the red-sandstone rock, and carrying up a quantity of iron dissolved in the water : as soon as this ferruginous water comes to the surface and is exposed to the action of the atmospheric air, we get a deposit of iron thrown down which amalgamates the particles of the sand contiguous to it, and the result is that a conglomerate mass is produced. This thickens so long as the causes continue to operate, and also extends its dimensions according to the strength of the spring. The result is a moor-pan, generally from four to eight inches beneath the surface; this acts like a basin, and as a natural sequel we find the moist soil resting upon this pan producing aquatic plants and mosses, which after many years produce a bog or

moss. All that is necessary to lay any of these bogs dry is to break an aperture in the side or bottom of this natural basin, and an outlet for the water is immediately made. Here, then, we see the cause and the remedy for the frequent bogs which are met with upon the red-sandstone formation.

Southwards of the line between Broseley and Ryton we find an extraordinary variety of soil, for, although the entire district is remarkable for rapid transition from the extremes of sand and clay to all the intermediate soils, yet here it is more particularly so. Fields are very often met with containing two or three totally different soils, and furnishing a good apology for crooked fences by the remarkably correct manner in which dry and wet land have been separated from each other. I have seen instances of dry land suitable for sheep rendered unfit for them by throwing down fences and the addition of unsound land: here then is fair cause for caution.

The land around Bridgnorth is exceedingly good, as also at Chetton and Earlington. As we pass from hence towards Quattford we have Mr. Whitmore's beautiful Seven Meadows below us, and after passing the rich alluvial deposit of the Severn valley we come upon a strong red loamy soil, which occasionally becomes rather more sandy in its nature. From here to the border of the county the bold and beautiful scenery will charm the tourist, whose patience and pedestrian powers have enabled him to perambulate this interesting district. Having taken the reader through it with as much rapidity as possible, I must proceed to report by what means it is turned to the practical advantage of its occupants.

This is a thorough *sheep-farming district*, showing the extremes both of good and bad management. The general system of working the land is on the four or five years' course: of *roots*, *spring corn*, *seeds* for one or two years, and *wheat*. It is sometimes varied where we get heavier spots of land, but this is the general course of cropping. In many cases the rotation is modified thus: *Green crop* followed by *roots*, *spring corn*, *peas* or *pulse*, *wheat;* and as this offers fuller scope for observation, I shall follow this sequence.

Green Crops before roots are only grown on the best and warmest land, and by those energetic farmers amongst us who lose no opportunity of making their farms as productive as possible. The corn stubble having been broadshared and cleaned receives a coating of dung. In disposing of this dung the vetches have the prior claim, and generally take the lion's share. We endeavour, as far as we can, to give the ground seven or eight cubic yards of dung per acre, which being ploughed in we commence our sowings of vetches, dividing the entire breadth into

five or six sowings. The seed is drilled at the rate of three bushels per acre, and the sowings extend through October and November. Where no dung is used the succession of the sowings is not delayed so long, for land with dung will be quite two weeks sooner ready for feeding. Amongst the early sowing it is very common to intermix some oats or rye, to give the vetches an earlier start in the spring. A good crop of vetches often leaves the ground very puffy and loose, so much so as to be unfavourable to the growth of roots; and I have seen great advantage resulting from the ground being thoroughly rolled and compressed before the roots are sown.

Trifolium.—The French or crimson clover has been tried with success, but its culture has not been extensive. Many failures have arisen in its growth from giving the land *too much* preparation. It is by far the best plan to sow 15 or 18 lbs. of the clean seed on a *clean* stubble without any preparation, harrow it very lightly, and then roll it as firm as possible. *It gives valuable fodder, and its growth should be extended.*

Rye is sometimes grown for *very early* feed for ewes and lambs, and for such it certainly is very useful indeed, being the earliest of our spring crops and consequently welcomed by our shepherds.

Saintfoin is grown in the south-west portion of this district, and where a calcareous soil exists it answers very well. Although useful as a spring food it is not here that its value ends, for, as the crop remains for two and sometimes three years, it in a great degree takes the place of the clover plant, and especially where the latter is found to fail.

Lucerne.—This is a crop which is very much neglected, but deserving of greater attention and more frequent cultivation. It is especially suited to soils which contain lime, and will not flourish when this is absent from the soil. Its natural district is therefore on the soils formed from the limestone rocks, but still it is capable of remunerative growth where the supply of lime is near and cheap. The suitability of the soil is a great element of success, and must not be overlooked. The preparation of the land should be *deep*, and if it follows *a well-cultivated* root crop this will be sufficient. After the roots are removed or consumed the land should be laid up rough for the winter, and being broken down and well worked in the spring the seed may be drilled in April about 9 inches wide. From 12 to 16 lbs. of *good* seed should be allowed to each acre to insure a thick plant. It will last for several years, and may be mown three or sometimes four times a year. Every autumn it should have a dressing of short dung, which will nourish and protect the plant. When the plant shows a tendency to weakness, fold sheep upon it; and

if the last growth is fed on the land it will materially strengthen the plant. Especial care must be taken to cut the crop when coming into bloom, for nothing tends more to wear out the plant than allowing it to get too forward.

Italian Rye Grass is another of our valuable but much-neglected fodder crops. This will be suitable when the soil does not admit of the growth of lucerne. To the sheep-breeders of this district this has been most valuable wherever it has been grown, and I am glad to say its growth is extending rapidly. The land may be laid down with this, as in the case of ordinary seeds, with a corn crop, but the subsequent growth is very much better if sown *without* corn. About three bushels of seed is the usual quantity sown per acre. If there is any sloping field below and near the homestead over which the liquid manure can be carried at a small expense, on such a spot the Italian rye grass will answer well. It is not particular as to soil, but it needs good tillage in preparation: then the liquid manure will contribute much to its luxuriance. Being near the buildings is also desirable, as it should be cut and carried from the ground, and the ground watered immediately after, so that the irrigation may follow the scythe quickly.

Rape is also grown as a spring crop, but it is not a general favourite, being considered apt to scour the sheep from its juicy nature. In the autumn, however, this is very different, as it then yields firm and strong food. The objection to it as a food in spring is no doubt owing to the growth being made whilst there is an abundance of moisture, and when the climate is dry this objection does not apply. My own experience leads me to believe that this objection may be very much overcome by altering the cultivation in the following manner. Instead of sowing as is usual in August and September, let the seed be sown in the early part of July, and the crop properly hoed out. We thus get a crop of autumn rape, which being fed off remains and shoots out beautifully for the spring, but being produced from older roots it is firmer and less juicy in its nature. If the rape is wanted *solely* for autumn use an earlier sowing is desirable.

Root Crops.—Mangold-Wurtzel.—The land appropriated for this crop is not sown with a green crop, but its cultivation is advanced so as to prepare for early sowing. Clearing the surface is the first step, and as this land is very subject to couch-grass the first attention is given to it. Many broadshare their stubbles regardless of its existence, and thus rather add to their troubles, as cutting into smaller pieces has the tendency to increase rather than diminish the growth of this weed. If, therefore, there is couch in a field, before anything else is done this should be destroyed. Forking and picking are

beyond question the cheapest and most effectual mode, and if done immediately after harvest we take the plant at its weakest time, and when its appearance amongst the stubble is most readily noticed. Some who are scrupulous respecting the value of vegetable matter hesitate about burning it, and prefer putting it in heaps and rotting it, whereby much is again distributed over the ground. To so great a pest no quarter should be given, nor should we be satisfied that it will not cause more trouble until we see its ashes.

The land being cleaned of the couch-grass and its kindred—for it has the black-grass and other near relatives in different neighbourhoods—the surface may be cleared off by the broadshare and harrows, and the weeds thus collected burnt and spread upon the ground. Some may consider it a loss to adopt this mode: a slight and very temporary organic loss does occur, but it is incomparably the least loss of the two. We are not half careful enough against the re-distribution of weeds. We often take great care in gathering, and making into a rotten mass, and then spreading again over the land much that is destined to give us future trouble. This is especially the case with farmyard dung, into which the seeds of weeds are allowed to pass in the assurance of their destruction during the rotting of the dung. It is forming far too low an estimate of the vitality of seeds to think so; and there are few farmers, if any, who are not adding *foul* manure to the land, which is to give them trouble at some future time. It is far better effectually to destroy such matter by burning than, from any false notions of economy, to perpetuate these troublesome trespassers.

The next step is the breaking of the land; and the most successful growers of mangold-wurtzel always double-plough their land, by allowing one plough to follow on the track of the preceding, whereby they gain a furrow of 12 or 15 inches deep, and thus it lies for the winter. Early in the spring it is again ploughed 8 inches deep, and is then thrown into ridges 27 inches wide, between which dung is spread at the rate of about 12 to 16 yards per acre. The artificial manure used is generally drilled with the seed, but I very much prefer sowing the *guano* broadcast before the ridges are split upon the dung. The usual allowance of artificial manure is, guano 2 cwt., and superphosphate of lime 2 cwt., mixed with ashes, so as to make 25 or 30 bushels per acre for drilling. The quantity of artificial manure may be often increased with considerable advantage; for it should be remembered that, whilst the general tillage expenses remain the same, whether we have a large crop or a small one, yet it frequently happens that, by a more liberal dose of the artificial manure, we make a very great increase in our crop

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without much additional outlay. I would, therefore, suggest the increased use of artificial manures for root crops, as being the most effectual mode of increasing the produce (over and above the usual yield), and thus well repaying the cost of this *additional* allowance.

The Globe is the sort generally grown, being considered a surer cropper than the Long variety; but where a good preparation is made the Long Red will be found to produce the heaviest crops. The Globe no doubt answers best under a rougher mode of management. They are gathered and stored in caves, as already described for roots (p. 35). The cultivation of this root is of unusual importance in this district, because of the scarcity of grass-land on many of the farms. In such cases, if the breadth in clover is increased, the produce of corn is necessarily diminished; or if the clover is fed, then there is a difficulty, because of the hay being required. The mangold, therefore, becomes peculiarly valuable, as affording a supply of food up to the end of June, or even July, and thus enabling us to keep off the clovers, and secure our crop of hay. I have known *temporary* yards to be made for carrying out the consumption of the mangolds, so as to give the stock kept in yards during the early summer months plenty of room for exercise and shelter. This being pre-arranged, the mangolds are drawn so as to be in a convenient situation for supplying the stock.

Swedes.—This is the standard root-crop of this part, and even better suited to the climate than the mangolds. They are often grown after a crop of early green food, such as rye, or rye and vetches; but far more generally without any such predecessor. The cleaning, ridging, and manuring of the ground is the same as that already described for mangolds. The width is not generally as great between the rows. Few persons take sufficient trouble in mixing the manures to be drilled. It is far from being a loss of labour to have the manure, ashes, &c., thoroughly mixed together, and sifted over *twice*. This favours its subdivision and distribution, and consequently increases its utility.

On the heavy portions of this district there is a general clearance of the crop from the land; and there are few farms even in dry districts which have not one or more fields each year requiring the crop to be drawn off. When this has to be done, there is nothing like a concentration of strength, so as to clear the land before any change of weather shall interrupt the work, because this is generally followed by such a treading of the land as completely to destroy the effect of all the summer operations. It is scarcely necessary for me to say, that upon such fields swedes are generally grown, because, as the crop has to be drawn, these are most useful at the homestead.

Carrots are grown freely over the district, but are simply looked upon as an occasional crop, and valued more as suited for horses or any choice fatting stock, sheep especially, as a change of food, than for any other reason. They are fickle in their growth and delicate feeders. When preparing for them, we proceed as if for mangold-wurtzel, with the double ploughing after clearing the land, and then sow with some wood-ashes. This suits them better than any rank manure, and, although I have seen large crops grown with the aid of liquid manure, yet this has always been most successful when supplied freely, but *very weak*, again giving proof of the preference for *a mild manure.* On the lighter portions of this district they may be grown successfully and profitably, and their great value for feeding is a recommendation in their favour.

Parsnips are not grown largely, but where the land is too strong for carrots they are an excellent substitute, and are of equal if not superior feeding value. Their growth may be advantageously extended.

Potatoes.—The disease, which has for about ten years continued to attack this crop, has very much limited their growth and tended to render it unprofitable. Early planting of early sorts appears to be the best plan for mitigating its attacks. Autumn planting, 8 or 9 inches deep, has been useful, and, in some cases, very successful, the great point being to protect the young shoots from the spring frosts. Others cut off the haulm, and remove it from the ground as soon as they hear of the disease, and this certainly has been very beneficial. The roots remain and ripen in the soil until the usual time of digging. Under any circumstances an early sale is desirable, for the disease may slumber in the roots, whilst they appear in every respect perfectly sound; but yet, sooner or later, the disease will appear and the root decay.

Corn Crops.—When the land has had the roots drawn from it, it is usually sown with spring corn, but sometimes with wheat.

Barley, of excellent quality, is grown throughout this district: the produce is not large in the west and south-west, in consequence of the climate being unfavourable, but throughout the east and north there is a fair produce. It is always sown as early as possible, these sowings being found most successful. In preparing the land for barley the ground has two ploughings, and is well worked, for barley likes a fine seed-bed. As early as this can be done (even in February) the barley may be sown. It is almost always drilled, and about 2½ or 3 bushels of seed per acre used. I have known late barley very much accelerated in its growth, and rendered equal to some sown

earlier, by having the seed damped with water and dried by sifting some guano over it. It is no doubt a good plan, for it certainly has a beneficial influence on the early maturity of the crop. In the south-west part of the district, and towards the Welsh borders, the barley, although of good quality, does not average above 30 bushels per acre, whilst in the remainder it may be taken as varying from 35 to 45 bushels, according to the season. There is not sufficient attention given here to a change of seed. The seed-barley is sown over and over again without this necessary change. Some barley which had been procured from the Lothians was recently tried, but it did not succeed better than the local seed. My own experience is decidedly in favour of going to a *more favourable* climate for barley, and the chalk and limestone districts to the south will be found the most advantageous seed markets. I have known 50 bushels of barley grown to the acre, when the increased produce could only be referred to a change of seed. The greater part of the barley grown finds a good demand amongst the maltsters around, and is considered to make malt of excellent quality. A small proportion only is consumed on the farms in fattening stock ; it would, however, be better if more were used in this manner, or if when sold a substitute were regularly purchased.

Oats are not as extensively grown as barley, but where the land becomes heavier and more tenacious the oat is more suitable and again takes the lead. Here, also, early sowing is in favour and certainly answers best. The black Tartary oat is grown upon the poorest land, but the potato oat is most general on the best land.

Spring-Wheat.—The impression is becoming more general amongst farmers whose land is in good order, that wheat may be taken twice in the course, with as little injury to the land as if one crop of oats and one of wheat had been taken in the usual manner. It is objected to by some landlords ; but I am disposed to think that, so far as the landlords' interest is concerned, there need be no fear of any injurious results.

Clover or Seeds.—The seeds sown under spring-wheat grow better than under any other spring-corn, and, consequently, this favours the growth of this crop. The successful growth of seeds is especially valuable on farms in this district, where the grass-land is scarce. Sheep-breeders are fully aware of this, and hence they persevere whilst there is any hope.

Wheat usually follows the breaking up of clover-leys. We prefer sowing the wheat upon a stale furrow, although a few think otherwise. The land is ploughed about 4 or 5 inches deep, and then allowed to lie for some time (two, three, or even four

weeks) before being sown. The *latest* sown wheat generally answers best, hence November and December are the principal months for sowing. Towards the west of the district the climate is not so favourable, and an earlier sowing is preferred. Here, also, the red wheats are adhered to, but in other parts all the best varieties of white wheat have been successfully grown. The quality of the corn is exceedingly good ; but still the average is not equal to what such land would yield in the east of England. A crop of 48 bushels is rare. I have known this quantity occasionally grown, still even 40-bushel crops are confined to the best land, and the average over the best portions of this district cannot be set down as above 35 bushels. Pressing is almost invariably admitted to be of great importance upon land to be sown with wheat, unless it is of an adhesive nature. Various expedients are adopted for effecting this, but it is generally done by a regular land-presser. I have seen it done with one of Crosskill's rollers, for which purpose every alternate ring was taken off and a washer substituted ; thus the pressers were kept 9 inches from centre to centre. Two of the rings were fixed outside the frame, thus increasing the width covered by the implement, and enabling 12 acres to be rolled instead of 10 acres.

Where the land becomes heavier than usual, there the water-furrows are always carefully attended to, and the neatness in which much of the land sown with wheat is finished off is most commendable. I am well aware of the many objections raised to this passage of water over the surface. Certain advantages are pointed out as arising from a passage of water *through* the soil—doubtless of great importance *if they can be realized*—but the least observant must be aware of the manner in which clay soils shrink on drying and expand again when wet. This is familiarly shown in the cracks of our clay-fields in the summer ; as these soils become dry so there are a number of passages for water into the soil, but as soon as the rain falls—and even frequently before this, if the air is damp—the swelling of the clay closes up the apertures, and the result is that the water stagnates on the surface for a time, unless it has water-furrows to carry it off. I have seen some rather strong land in some parts of this district laid perfectly flat (but such land has in each case been freely and deeply cultivated with plenty of decaying manure in it), still I cannot say that I consider it a preferable plan for *general* adoption upon land of this class. At any rate, there is strong evidence in favour of the practice of surface-drains. It is scarcely necessary for me to add that these remarks are not intended in any way to interfere with the question of under-drainage, which is perfectly independent.

Grass-Land.—Although this district has some good grass-land along the banks of the Severn and other streams, yet the proportion is small, and does not call for any further comments than have already been given for the other districts. I may, however, remark that W. Whitmore, Esq., of Dudmaston Hall, has had some very beautiful water-meadows formed on the sides of the Severn near Quattford. They are well planned, and no doubt were formed at a great expense by the proprietor, but I fear their value is not fully appreciated.

Live Stock.—*Cattle.*—This district certainly does its share to keep up the high credit of Shropshire for horned stock. We have herds of Short-horns and Herefords of the highest degree of merit. The Right Hon. Viscount Hill has one of the best herds of Short-horns; but, with all the good qualities of this justly valued breed, we do not find them equal to the Hereford for exposed situations, poor keep, and such similar conditions; and although his lordship has some beautiful Short-horn cattle and South Down sheep, which have gained prizes at the Royal Agricultural Society's shows, and also at Birmingham, and realized large prices from their sale to foreigners, yet it must not be anticipated that similar success will always follow their extensive adoption in this country.

The almost universal experience of this district is in favour of the Herefords, as being the most remunerative class of stock for general purposes. Lord Berwick's herd of Herefords stands first in the county. If we look at the national shows of the Royal Agricultural Society as the challenge-ground, his lordship's herd certainly stands high. I observe that from 1849, when Lord Berwick first commenced to exhibit, up to the Salisbury meeting of 1857, nearly 400*l.* has been awarded to this stock as prize-money, not taking any notice of descendants shown by other exhibitors—a fact which confirms the high reputation of this herd. The chief portion of Lord Berwick's herd is sold to French, American, and Australian breeders, at very high prices; and certainly, wherever they go, they are a credit to the country in which they are bred.

The price of well-bred Herefords necessarily varies with the stock from which they are bred; for here, as in other breeds, the value of pedigree, so highly and justly esteemed by the Short-horn breeder, is beginning to be rightly understood: thus bull-calves have been sold from herds of medium position for from 40*l.* to 80*l.* each, whilst Lord Berwick has realized very much higher prices. There are many excellent breeders of Hereford stock in this district who, whilst they do not contest the pre-eminence with Lord Berwick's herd, still supply stock of first-

class quality. They realize good prices for their stock; for instance, 20*l.* for a three-months-old heifer calf, and 40 guineas for a yearling heifer. The large number of Hereford calves which are kept for bulls necessarily reduces the number and quality of the steers, for none but the culls are kept for steers. There are times, of course, when a breeder who has to gain reputation makes a sacrifice of one or two good bulls, in order that he may show steers of unusual quality; when, however, he has gained this position, he is reluctant to make these sacrifices to a greater extent than is absolutely necessary.

Leaving these first-class Herefords, we find stock of exceedingly useful and valuable character general throughout the district. Here we often meet with Hereford bullocks on poor and exposed farms, showing a quality and condition surprising to those unaccustomed to this breed. On such land the old grey-faced Hereford is preferred, as being more hardy than the less curly-coated red Hereford. From such cold and exposed land I have known steers sold,* at 3 years old, weighing 16 score per quarter, and steers only 21 months old fetch 25*l.* each. The cross of the Short-horn has been tried in many cases, without such success as justified the repetition. On the colder parts of this district they proved to be decidedly inferior to the Herefords, and did not make equal growth upon the same food. Another agriculturist † gives as his experience, after 30 years' extensive trial, 'That nothing will equal the Hereford for this district for producing fat, early maturity, and hardiness of constitution.' He sells his steers, two-and-a-half years old, for very nearly 30*l.* each, and, in one instance, he sold a two-year old for 30*l.*, and it weighed 13 score per quarter. Mr. Shirley, of Bawcott, brings his bullocks, at two years old, to average 11 score per quarter, and, for the last two years, he has sold his bullocks at this age for 25*l.* each.

Sheep.—The Shropshire Downs take the lead of all other breeds throughout this district; none can equal them, and few offer any competitive opposition. We have sheep of the highest quality, bred in various parts of this district, and although we find excellent Shropshire Downs in District No. II., yet the best and choicest flocks are found in this. Mr. Henry Smith, of Sutton Maddock, near Shiffnal, has a first-class flock, and has been a very successful exhibitor. The sheep shown at Birmingham in Dec. 1856 and 1857 are in the highest degree to his credit, especially as a young breeder. His annual sale

* By Mr. Carter, Manor-house, Alcaston.

† Mr. Taylor, Burleigh-villa, Wellington.

and letting of rams have been most successful. This year they ranged up to 60*l.* each. Messrs. Cranes of Shrewsbury have realized equally high prices. Messrs. Meires have, for many years, held a very high position as Shropshire Down breeders. The flock of Mr. Green, of Marlow, has a very wide and well-merited reputation. If he fed higher he would realize much higher prices, but he does not approve of a forcing system, and, besides this, he stocks heavy. At his annual sale he disposes of 60 to 70 rams, which average 10 or 12 guineas each, and 200 to 300 ewes, which also sell at good prices. This flock is noted for being very prolific—a most desirable feature, for which the Shropshire Downs as a class stand high. The average number of lambs reared may be said to vary from 30 to 50 per cent. more than the number of ewes.

Mr. Horton, of Harnage Grange, near Shrewsbury, has bred some first-class sheep, which have taken prizes at Dublin, Gloucester, &c. He was offered 120*l.* for his two-year-old ram, which gained the prize at Gloucester. His rams have been let at from 10*l.* to 42*l.* for the season. The late Mr. Farmer, who resided near Bridgnorth, had a very good flock, which was sold in September, 1857, when one pen of ewes sold for 15*l.* each, and none under 8*l.* each. His rams sold in some instances for 50*l.* each, and 20 rams averaged above 20*l.* each. This, however, was a sale of the entire flock, and not simply the culls. The culled ewes from the flock of W. O. Foster, Esq., Kniver Hall, average 6*l.* each at their annual sale. Mr. George Adney, of Harley, near Shrewsbury, has a splendid flock. This gentleman and Mr. S. Meire were very successful at the Salisbury show, both carrying off prizes. This admission of the Shropshire Down sheep is by a recent alteration of the rules and regulations of the Royal Agricultural Society, and I trust it is the first step towards this breed being placed in a more prominent position in our national exhibitions, and their having prizes specially allotted to them. It is a most valuable breed, especially from the fact of their combining *weight and quality*, two very essential points for a *remunerative* stock. The prices stated above show how highly they stand in public estimation.

Besides the above, there are many excellent flocks belonging to men who simply breed for mutton, and not for the sale of breeding stock. Many of these are of sufficient character to justify their sale for breeding stock, and no doubt as the demand increases for the Shropshire Downs they will be pressed into the service; at present, however, they do not take this course. Here you generally find a medium degree of fineness held to as most remunerative. Mr. G. M. Kettle, of Dallicott, near Bridgnorth, has a splendid flock of sheep, combining good character with a

high degree of remuneration for the sheep-farmer. There were 3 very good wethers from this flock (33 months old) exhibited at Birmingham (1857) which weighed 50, 46, and 45 lbs. per quarter respectively, and yet they were beaten by other exhibitors. The culled ewes from such flocks would average from 25 to 28 lbs. per quarter when fat, and the wethers at twelve months old would be above 20 lbs. per quarter. These are good weights for *Down* mutton. Quality is very highly esteemed amongst the majority of breeders, and the general experience of this district is that if extra weight is gained by a sacrifice of quality it is purchased too dearly. Even on the poor land they care not how heavy they can get their sheep, provided they can keep their quality.

The introduction of the South Down blood has been tried very extensively, and some breeders have got their flocks exceedingly tender by doing so; unless done with great care and judgment it produces no advantage, but simply decreases the weight and hardiness. The same may be said in a more marked degree of the cross from the Leicester. The cross-bred stock have been generally considered, not only to consume as much food, but they do not make such heavy sheep nor are they so prolific. I have been favoured by Mr. Kettle, of Dallicott, with the weighings of some pure Shropshire Downs, and also half-bred Leicester and Shropshire Down which he fattened, and they confirm this general impression. On the 4th of April (when nearly 14 months old) they were weighed.

	lbs.		lbs.
The 5 Shropshire Downs weighed	715	=	143 each.
The 5 Cross-bred Shropshire and Leicester ..	684	=	137 each.

They were kept alike up to the following December and then weighed:—

The Shropshire Downs.	lbs.	Shropshire and Leicester.	lbs.
Average in December ..	202	Average in December ..	189½
Average in April	143	Average in April	137
Gain	59	Gain	52

This proves the growth to be less rapid throughout the entire period, and what is even more surprising, the half-breds cut less wool than the Shropshire Downs.

The quality of the Shropshire Down wool is exceedingly good, and the fleeces average a good weight. Mr. Greed, of Marlow, cut a fleece 12½ lbs., which on being sent to the Paris Exhibition, carried off the first prize. The fleeces from ewes average from 5 lbs. to 8 lbs; wethers fifteen months old cut 7 lbs. to 8 lbs.; yearling rams 8 lbs. to 12 lbs. Some rams cut 14 lbs.,

but this excessive weight is, in general, accompanied with a coarseness which depreciates the value of the fleece. As far back as the fourteenth century we find the Shropshire wool considered the choicest and dearest in England. Smith* gives the following statement:—

	To the Staple for Home Use.										For Exportation.				
	Per sack.			Per stone.		Per sack.			Per stone.		Per sack.			Per stone.	
	£.	s.	d.	s.	d.	£.	s.	d.	s.	d.	£.	s.	d.	s.	d.
Salop	6	6	4	5	9	7	6	4	5	9	9	6	4	7	3½
,, including Leicester	5	6	8	4	2	6	6	8	4	11	8	6	0	6	5½
Nottingham	4	13	4	3	7	5	13	4	4	4	7	13	4	5	10½
York and Rutland ..	4	10	0	3	5½	5	10	0	4	2½	7	10	0	5	9
Derby	3	3	4	2	5	4	3	3	3	2	6	3	4	4	8½
Cumberland and Westmoreland	2	13	4	2	1	3	14	4	2	10	5	13	4	2	4½

Subsequently, in a work published in 1694, it is stated, "Our Shropshire wool is not to be equalled in its kind by any part of the world and is suitable to almost any degree of quality." As I have shown above, it still holds a very high position for quality. The weight of the fleece is very dependent upon the keep, but at no time of the year is the influence of good food greater than in the spring, when the days lengthen and the sheep again commence their growth. Improvement of the food at this time has a very marked influence, although it cannot overcome the effect of previous scarcity.

The ewes generally commence lambing from the middle of February to March. A few breeders may be earlier, but this is only found to answer when extra care and protection can be given to them. As a rule lambs dropped between the 1st and 14th of March are found as forward as those born between February 14th and March 1st, especially if the early season is unfavourable. The late lambs then make a good start, whereas the early lambs are often checked and never afterwards go on so rapidly. When it is desirable to have lambs early it is especially necessary to give them comfortable shelter, and even for the later lambs it is not only more humane but also more remunerative. The lambs are generally weaned in the middle of June, and then they go on good clover, upon which, with an occasional change to a piece of vetches, they are kept until ready to go upon rape or early turnips in the autumn. When they have swedes these are cut for them, and they also have access to hay, which keeps them

* 'Chron. Rusticum,' published 1641.
† 'The Interest of England,' p. 4.

firm and thriving. As the spring advances some give them corn, which has a very marked effect upon their growth and wool. The swedes generally last until the winter or spring vetches are ready, upon which, with the clover, they are generally finished and sold in May. Those kept through the summer are dependent upon clover and vetches or else permanent grass, but the proportion kept after May is small.

One of the great evils which we have to contend with amongst our flocks is the foot-rot, and certainly this is a serious difficulty. It is now extending *over the bodies* of our sheep, and affects those parts of the body which touch the ground. Various remedies have been tried but none succeed except in very careful hands. There is much that is hidden from our knowledge respecting this disease, and so important is it to the interests of our flockmasters that a searching investigation should be instituted into its nature. I have been very much struck with this fact—which applies equally to other counties as well as Shropshire—that as the use of lime as a manure is decreased so the foot-rot increases. Thus I find that — other circumstances being equal — those farmers who use most lime are least subject to rot. This inference is in some measure supported by the fact, that those who are most successful in curing the foot-rot are in the habit of letting the sheep stand on a floor covered with quick-lime, after the feet have been properly dressed. I always have the feet thoroughly pared where there is a tenderness; upon the sore I sprinkle some powdered bluestone, and then having put on some tar, I let the sheep walk on this bed of lime, and I am very successful in keeping free from the rot.

Implements.—Few districts can produce a better collection of improved implements than the one now under notice. There are very few fixed steam-machines connected with homesteads, this description of labour being chiefly done by portable engines, of which there are many travelling through the county. Reaping machines are also used, and very much approved of both on the ground of economy and expedition. The best descriptions of drills, harrows, ploughs, and rollers, manufactured by the leading implement-makers, are also in frequent use. The chain harrow is much liked, especially for gathering the couch.

Farm-buildings are exceedingly good in the majority of cases; and although it is difficult to point out any extensive erections specially arranged for carrying out expensive systems of farming, yet still the homesteads of Shropshire are, as a whole, excelled in few counties.

Draining.—The greater portion of this district has a natural drainage, but there are small tracts upon it which require arti-

ficial drainage. I have met with several instances where the expense of drainage has been considerably reduced by the formation of a swallow-hole (or, as locally termed, swilly-hole). By sinking an opening into the porous rock beneath, an excellent outlet is immediately obtained, and to this point the general drainage of the field is directed. Draining-pipes are almost always used, and they are usually laid $3\frac{1}{2}$ or 4 feet deep.

The Labourers.—The supply of labour is rather deficient, and none need be out of employment who are able to do farm-work, for there is ample work for all. They generally receive 11*s.* a-week wages and two quarts of beer daily, which adds about 4*d.* a-day to the pay. If they do not have their drink, then 12*s.* a-week are paid. In harvest-time the supply of beer is almost unlimited and the wages are increased. I do not consider it a good practice to supply liquor throughout the year, but at harvest-time, and especially when a period of emergency arises, it is necessary to give the men an additional stimulus to enable them to perform the excessive labour required. Considerable help is obtained in hay and corn harvest from Welsh and Irish labourers, who come over in large numbers.

The cottages for farm-labourers are very few, and these have much need of alteration. Habits of cleanliness cannot be encouraged in them, nor can even the rules of decency be observed in the *majority* of these cottages. Scarcely any have more than two bedrooms, in which the whole family have to locate. Often they are obliged to have a lodger, in consequence of the deficient accommodation in the neighbourhood. More cottages, and of better character, are sadly wanted. It is *a duty* which loudly demands the attention of the proprietors of this district, and it devolves upon them to supply this need, even if the interest upon the outlay is not as great as might be wished. The want of a comfortable home is a great inducement to emigration; nor can we be surprised that young and prosperous labourers should seek in other countries the opportunity of realizing better pay, more comfort, and independence, when they find their homes deficient in comfort and without any probable prospect of improvement. If good labourers are to be retained, their homes must be improved.

This deficiency of cottages—many farms of 300 acres not having above one cottage—compels the occupant of the land to board a number of servants in his own house, which is a very expensive and inconvenient mode of securing labourers. I have been favoured with the plan upon which the Duke of Bedford's cottages are built. They are so excellent in their arrangement, and the requirements of the district are so pressing, that I feel it

desirable they should be more generally known. The economy of their construction is a very important point, *in addition* to the proper accommodation which they offer, and which is so important for the comfort and morality of the labourer's family. There are many local societies for promoting and encouraging the industry and progress of the labourers, but these differ but little from other similar societies. There is, however, an industrial school at Quatt which is well worthy of notice. It certainly does a considerable amount of good, and one cannot but regret that its benefits are confined to pauper children.

Mr. Jarland, the able superintendent of the school, has published a statement in a pamphlet, entitled "District Labour Schools," which is in the highest degree satisfactory. In this school the boys receive, not only a plain useful education, but are made really valuable farm and household servants. The boys are accustomed to farm operations; and, as a proof of their ability, Mr. Jarland informs me that at the Bridgnorth Agricultural Society's digging-match four boys were entered as competitors, and carried off the four prizes; and in 1855 they carried off three out of four, although competing with older hands. I can from my own observation testify to the neatness and good execution of the work, and the tact of the master, who encourages a laudable spirit of emulation amongst them. The girls are trained to domestic duties, and are very valuable servants. It is not fair in this instance to expect that the entire expense of each boy can be repaid by the produce of his labour: there are many of the boys whose labour fully pays the expenses incurred, but that of the younger ones cannot do so; still they become ready for service, and as soon as such is the case they are placed out. Hence, as the system is only a preparation for enabling them to get their own support, it cannot, under any circumstances, be a paying concern. It is, however, certain that a number of valuable labourers have sprung from, and will continue to spring from, this industrial school—having good moral character combined with a degree of intelligence which cannot fail in the majority of cases to make them valuable in their station in life.

Tenure of the Land.—With few exceptions land is held under yearly tenancies. There appears to be much objection to leases on the part of the owners, and certainly the occupiers have seldom made improvements which render a lease necessary. Agricultural agreements must sooner or later assume more of the character of commercial transactions, due security being given to both parties, each claiming it as his right, and not simply as an act of favour. There are some instances of a fixed compensation being given to tenants, who, having made improve-

ments, leave the farm without having reaped the fruits of their outlay, and the following is the scale generally adopted.

If *Draining* is done by tenant the landlord pays—

17*s*. 6*d*.	in the pound	at the end of	1st year ;
15*s*.	,,	,,	2nd year ;
12*s*. 6*d*.	,,	,,	3rd year ;

and so on, decreasing $\frac{1}{8}$th every year.

Where *Orchards* are planted by the tenant, and left within eight years, the cost of the trees and interest is paid in full, subsequently decreasing $\frac{1}{8}$th every year.

Where *Bones* are used on tillage land, without a crop of corn, one half the cost is paid by the landlord at the end of the first year ; or one quarter at the end of the second year ;—on tillage land with corn, the landlord pays one quarter at the end of the first year ;—on grass land mown, it is divided equally over two years, but if not mown over four years ;—in the case of guano, lime, superphosphate, soot, and linseed cake, one quarter is allowed at the end of the first year. The allowances are generally fair, but that for lime is low : it should rather diminish $\frac{1}{5}$th every year that no crop is taken, and $\frac{2}{5}$ths if the crop is removed.

To show the usual mode of binding the tenant as to the outgoing crop, I may state that it is usual to restrict the number of acres to be sown with corn after notice to quit has been given or received. The corn allowed to be sown must be either upon well-manured fallow land or clover ley. One tenth of the crop is first allotted for tithe, and of the remainder $\frac{2}{3}$rds of the fallow wheat, and $\frac{1}{2}$ of the brush belongs to the tenant. But if the land is not properly fallowed it is to be considered as brush, and the tenant therefore gets a smaller share ; and if an extra quantity is sown the surplus belongs to the landlord, and he can choose the extra number of acres where he thinks proper.

In this Report upon the agriculture of Shropshire, it has been my endeavour to particularise the various points of practice in the several districts. I have offered suggestions where the practice seemed especially to require improvement, and I trust that I have fulfilled the object for which these reports on the agriculture of our English counties are prepared, so that the practice of the district may be improved, whilst other parts of the country may imitate any peculiarities which are worthy of adoption.

The Lodge, Puddyngton, near Crediton, Devon.

II.—*The Potato: its Culture, Production, and Disease.* By Jeffery Lang, M.D.

Prize Essay.

The culture of potatoes is so easily understood, and be the manner what it may, so very productive, that it is rare indeed to find any resident in the country who is not the proprietor of a potato-patch. Farmers also have encouraged the habit, supposing that the manure carried on the ground by the sub-tenant was of greater value than the rent and labour which they gratuitously provided. The ordinary method in this district was for the farmer in the autumn to plough down the field, generally an old ley; in the spring he had it cut back, dragged once or twice, and then left to the cultivator, who carried thereon 20 hogsheads of lime per acre, and all the other manure that he could get together. He also engaged to keep the ground clean and free from weeds, and to dig up and remove the crop before the 1st of November then next ensuing.

As each individual cultivator was thus left entirely free to follow out his own ideas, it became a not infrequent thing to see in one field very diverse methods of cultivation, yet all attended with successful results. The first, because oldest method, was that commonly called "*Lazy beds.*" The ground was marked out in beds 3 feet wide, with an alley 2 feet wide between them. The bed was dug and made light, the manure spread on it. Then the potato-set was planted rather at random on the bed, the manure drawn around the set, and then covered about 3 inches in depth with the earth from the alleys. When the plants were 2 or 3 inches high, the greater weeds were pulled out and thrown on the bed, which was a second time covered with earth from the alleys; and often this process was again repeated. Slovenly as this method undoubtedly is, it may still be frequently seen, and is certainly very productive.

The next method is the drill or single row. Herein, the ground being got into good tilth, the manure is spread on the surface of the soil; and either with the spade or the plough the potato-sets are planted singly in rows, at distances determined by the caprice of the cultivator, but generally about 12 inches from set to set in the row, with the rows from 18 to 30 inches from each other. Soon after the plants make their appearance they are "dug between;" when about 3 inches high they are "hoed up," and soon after are "earthed up." This is a clean, good system, and is very generally followed, but is the least productive of any. Now, we shall see by-and-by how the potato is produced; and it will be at once evident *that it is the*

"hoeing" and "earthing up," thereby cutting off the minute tubers underneath the surface, which no care of the master can avert, *that renders this method so unproductive.*

The third method is a modification of the two preceding. The sets are planted in rows singly, and the rows are kept just the same distance apart; but the earth is harrowed over with a fine harrow as soon as the sets are clearly distinguishable in the rows, and so left. This method is usually practised in ground that has been carefully cleaned, and is far more productive than the second. As it is, however, the interest of the proprietor to have his ground, when abandoned by the "potato merchant," left *clean* as well as manured, the second system only finds favour in his eyes, and is fast superseding the other two.

We will next examine how long the same potatoes can be grown successfully in the same ground. It has been averred that the potato soon wears out, and that a renewal of both seed and soil is essential to its well-doing.

In September, 1819, through the kindness of a friend, I obtained from Mr. Prettyjohn, near Kingsbridge, two bags of "golden pink eyes" potatoes. They were immediately planted between the rows of young apple-trees, standing at 5 feet apart, in two lines 18 inches apart from each other, and the same distance set from set, in a nursery of little more than half an acre in extent. And there they remained for twenty-six years (1819 to 1845); growing well and producing abundantly; yielding from 20 to 25 bags per annum, besides those which, in digging, were planted again for the next year's crop.

They were manured with about 16 cartloads of stable manure and 4 hogsheads of lime per annum; were usually dug up in the early part of August, and planted again immediately; and until 1845 were free from any disease. In the autumn of that year the nursery was destroyed, and numbers of the tubers were found to be diseased.

Now, in the last week in July, 1845, standing on an eminence on the north-east, and looking southwardly over a long orchard of 4 acres in extent, of which the nursery before alluded to formed the southern extremity, I was surprised at seeing a *broad band* of *blackened leaves* running diagonally across the orchard, bearing the direction of south-west to north-east, and in which band the apple-trees looked as if they had been scorched by fire. Within the lines of the band there did not appear to be a green leaf; the smell was fœtid and very disgusting. Passing downwards by the road fence to make a closer investigation, I found that the band of blackened leaves was about 1000 feet wide, resolvable into three, like stripes on a ribbon: of considerable intensity in the middle, shading out at

the edges. The leaves on the trees in the band were shrivelled and blackened, but firmly adherent; and, although I did not notice it then, I have since found it to be the fact that numbers of the young long shoots were strangely contorted. The grass in the orchard was very high.

A friend and my tenant, who were with me, saw these well-defined appearances as clearly as I did. On asking the latter what he supposed "*the cause?*" he said that he supposed it was "*lightning*." There had been in fact a violent gale from the south-west four or five days before, accompanied with much rain. The leaves on the blackthorn (*Prunus spinosa*) in the hedge-rows were shrivelled quite as badly as the apple leaves. The potatoes in the nursery plot, at the southern end of the orchard, were much discoloured *within the line of the band, but not at all beyond it.* We traced this black band of shrivelled leaves on to the next orchard; to another, a quarter of a mile away, to another half a mile off; to Torbrian, a mile and a half; subsequently to Fishacre; to Mr. Charles Bowden's orchards at Staverton, which were dreadfully cut up; to Velwell, in Rattery; about eight miles south-west across the river Dart, from where I had first observed it; subsequently to Abbotskerswell; across the navigable part of the river Teign, here of considerable width, to the higher portion of Bishopsteignton, making a total of fourteen or fifteen miles from point to point in a straight line. It was noticed throughout how distinct the confines of this band appeared; the band was considerably broader at the south-western than at the north-eastern extremity of the line surveyed, and every field of potatoes *within the line* was much shrivelled and cut. This was more especially noticed in Abbotskerswell, where, the line passing through a field, *the potatoes within the line* were much hurt, but *those without the line* at that moment appeared unaffected.

In about a fortnight or three weeks the disease was almost universal; the leaves universally blackened and shrivelled; the smell fœtid and very offensive. By the middle of August the alarm was general, and most persons set to work taking up the tubers; this operation was conducted with great care, every man having two baskets, so that the healthy tubers were separated from the diseased or doubtful as soon as they were exhumed. But shortly another and more fearful cause of alarm was felt, for the cause of disease—whatever that cause might be—appeared to concentrate its energies, and attack the exhumed tuber with increased virulence.

The only satisfactory way of endeavouring to cure any disease is *to ascertain the cause;* and, *if its method of propagation can be discovered, to try and arrest that propagation.*

To do this, it became necessary to ascertain—

I. Where, and under what conditions, the disease first appeared; and the period of its first appearance.

II. What conditions of the atmosphere were favourable for the propagation of the disease, or the converse.

III. On what portion of the plant did it first appear?

IV. Could it be artificially induced or prevented, and how?

V. Did manures in any way affect the propagation of the disease? and, if answered in the affirmative, would the use or employment of any chemical agent alter, check, or remove the disease?

In reference to No. I., it would appear from the foregoing observations that the disease was due to atmospheric agency; but the time when it had been first observed could not—the evidence being so very conflicting—be determined. If men whose accurate habits of observation and strict veracity could be relied on were correct, the disease had appeared in certain localities one or two years before 1845; but according to the universal voice it had in that year suddenly appeared in all its malignity.

II. *Atmospheric influence.*—Two or three years elapsed before observations could be made as to what conditions of the atmosphere were favourable to the propagation of the disease. This portion of Devonshire is remarkably free from fogs; they very seldom occur, and when they do they fill up the valleys to a certain height, rarely going over the tops of the hills. Returning from Okehampton to Exeter in July, 1848, I noticed on reaching the hill near the three-mile stone on that road that we were about entering a dense fog, which lay before us white and level. On arriving at the gate of a potato-field—which, being on our right hand, stretched up the hill—a friend who was with me gathered some sticks, and, walking up through the potatoes, came to the edge of the fog, which he marked with the sticks. Ten days after the potatoes below the sticks were a mass of disease, whilst *all above the line were not affected five weeks after.*

III. *Portion of the plant first affected.*—It has been asserted over and over again that the disease originates in the tuber planted, or in the stem that springs from it. *That opinion is a delusion.* The disease always originates in the leaf, sometimes attacks the stem of the leaf, more rarely still the stem of the plant; and in the *tens of thousands* of instances in which both I myself and the numerous men whom I have employed in every portion of this county have examined *the base of the stem next the portion of the tuber set, no one instance of disease has ever been discovered.* Nay, as good potatoes and as free from disease have been obtained, where proper precautions have been taken, from

diseased sets, as from those sets where no taint or disease could be discovered.

And here, in order to elucidate this matter, it becomes necessary to investigate *how and in what way the potato is formed.* Some dry and clean potatoes were placed on a chimneypiece in a seldom-used room. In due time they threw up stalks, short, thick, and studded with minute leaves, whilst on the summit of the stalk were three or four larger but still minute leaves, forming a tuft. Speedily from the axils of the minute leaves on the stems a shoot was thrown forth, terminating in two *leaves*, closely enwrapped the one by the other. It was the germ of the future potato, whose formation can by any one be rendered evident: the *inner leaf forming apparently the cells of the potato in* which the *starch is deposited*, whilst *the enwrapping leaf* forms *the skin.* This experiment has been witnessed by so many persons as to leave no doubt of its accuracy. When the tuber-producing shoot is about 2 inches long, it becomes easy to introduce it into a large bunch of soft moist moss, and in ten days or a fortnight a minute potato, not larger than a duck-shot, will be found instead of the two terminal leaves; and this experiment can be varied. By changing the position of the potato, one of the aforesaid shoots can be induced to become the future stem of the plant, whilst the *stem*, as originally intended, can be made to produce a potato at its extremity. It may also be observed *that these productive shoots from the axils of the minute leaves, if cut away, are never reproduced from that axil;* and it is very possible, with care, to cut away every one of them. That being done, the stem grows rapidly, and becomes long, branchy, and strong. If, now then, you lay down the stem—or, leaving it erect, you keep it moist and deprive it of light—you will obtain a potato from the axil of every leaf above the deprived portion; white, if kept in the dark; partly white, partly coloured, if partially shaded; and a dark purplish green, if exposed to the light. A damp or moist place is necessary; and frequently on these tubers a short strong shoot, with the two terminal leaves, may be seen; ready, if circumstances be favourable, to produce a second tuber; and as the stem where it proceeds from the eye of the tuber is more or less of a reddish purple, it has led to the mistake so often insisted on by many, "that *the disease often or always originates in the lower portion of the stem where it adjoins the set.* It is, however, quite a delusion.

IV. *Can the disease be artificially induced or prevented?*—A large 8-light melon-frame was so placed that along its southern front large "Irish blue" potatoes were planted, 8 inches deep from the surface, the first week in February, in 1846, 1847, and 1848. When the plants made their appearance they were exposed,

and their stems so regulated that one stem in every case grew outside and entirely uninfluenced by the frame, and *two inside within the frame;* and the two inside were separated from each other by a brick and mortar partition, so that each stem grew in a separate frame; and these frames I regulated in such a manner that *every alternate frame* could not be opened without my sanction. The sets were large, and had merely a bit cut off their end to promote their decay. No manure was used; the sets grew very well, and were regulated as described. Their progress was carefully watched. About the 25th of July in each year the first symptom of disease was apparent. The frames were now securely fastened, *so that no one of them could be opened, and so remained until the last week in August in each year.* The stems outside the frame were spouted with water by a syringe with a very fine rose, *especial care being taken that the under part of nearly every leaf should be damped each evening.* In *ten days* they were *a mass of disease* from bottom to top; *within the frame there was not a trace of the disease.* About the middle of the last week in August in each year every alternate frame was opened: two in the morning at 11 A.M., the time of closing 4 P.M.; the other two at noon in each day, closing at 9 P.M.: that is just when the dew is falling.

The result was exactly as had been anticipated; the two frames closed at 9 P.M. were in *three days diseased;* the other two frames closed at 4 P.M. remained without any appearance of the disease until the middle of September, when the frames being drawn up the stems and leaves were freely syringed, and left open for an hour. In a *very few days they were severely affected.* The stems and leaves were now carefully examined, and everything having the slightest suspicious appearance was cut out; these two frames were then carefully and permanently closed. The potato stems immediately made efforts at growth, pushed out stalks and leaves, *which were not affected by the last of October, when these experiments finally closed.* The four frames above mentioned had remained entirely closed and quite free from any disease until the middle of September, when, a hot clear and calm day being selected, all four were damped with the syringe, and a diseased vine-leaf being placed among the branches of the stems all four frames were closed and remained as before; no more time being occupied in the operation than was necessary. Having a vinery with four young vines, very healthy, and growing very vigorously, they also were freely syringed, and two branches of affected potato-stalks introduced among the vines; the house was closed and the air violently agitated; in little more than a week it was evident that the leaves of the vines and potatoes were diseased in numerous places; and

as the identity of the disease which affects the vine and potato was thus established, the brickwork of the walls was washed with 2 lbs. of flour of sulphur, mixed (by guess) with 5 lbs. of lime and half a pail of water; and being well stirred up, the front wall under the shelf was washed once, the back wall *twice* with this mixture. The effect was immediately to arrest the disease and prevent it from spreading. A larger vinery, 32 feet by 20, and filled with an abundant crop of grapes, was treated in like manner, and with similar success; and I may remark *en passant* that both houses have continued entirely free from disease to this day.

It will be evident from the preceding pages that a damp foggy atmosphere is peculiarly conducive to the propagation of the disease, whilst a dry atmosphere arrests its diffusion. Mr. Lowcock, then a tenant on Raddon Court, Barton, the property of J. Hippisley, Esq., near Crediton, offered me his assistance in testing these views on a large scale; and his wishes were most zealously seconded by his very able and intelligent assistant, Mr. Louis Reynolds. The result of numerous experiments proved, that in the bottoms or usually foggy ground the disease invariably appears early and is very severe; that a higher elevation escapes to a later period and is less severely visited; whilst higher still and near the top of the hill potatoes frequently escape altogether.

Many other plants were similarly affected. It has been noticed before that the visitation of the disease was first observed on the apple and sloe; the ash, maple, and *mulberry* followed; and then the elm, so extensively, that in the autumn of 1855, in this land of elm, no leaf could be discovered without the fatal blackened spot. Nor has the disease been confined in its ravages to this locality; the mulberry especially was early and extensively diseased, and the leaf being of considerable size and firm texture afforded very good opportunities for examining the *spread* and *progress* of the disease. Whilst these examinations were in progress, I was informed by a young friend that several of the silkworms fed on the leaves of a mulberry tree had turned *stiff*, *black*, and *died*, when of large size and just about to spin. In 1854, 1855, and 1856 I obtained papers of eggs from various places, which were hatched at very different times, but with one result. The larvæ were placed in trays and carefully attended to. All of them without an exception fed on the leaves, *not then diseased*, but *afterwards severely affected*, of a mulberry tree, died; all fed on the *leaves of a mulberry*, *not then nor afterwards affected*, *lived and spun well*, but the cocoons were unusually small, and it ought to be observed that this mulberry tree has had every year in the month of May several pounds of flour of

sulphur carefully raked into the earth underneath its branches. The remainder of the larvæ, fed exclusively on lettuce-leaves, were not affected in any way. If these results be correct—and they were seen by so many persons almost continuously, that any error must have been detected—they demand earnest and immediate attention; for they point out to the commercial and manufacturing world the reason of the less abundant supply of silk, the cause and the remedy. It was observed, that the disease *always appeared first on the leaves or stalk of the Japan lilies* (Lilium lancifolium), and twenty-one days after its appearance there it will be found affecting the potato.

V. *Do manures in any way affect the propagation of the disease? and, if answered in the affirmative, would the use or employment of any chemical agent alter, check, or remove the disease?*—In 1846, 1847, 1848, 1849, 1850, five consecutive years, assistance in answering these queries was obtained from *Aylesbury Common*, a tenacious clay soil resting on large water-worn pebbles mostly of a silicious character, Mr. Westlake then occupying this cold and tenacious clay estate; *from Dartmoor*, a purely granitic soil 1100 feet above the sea, by Mr. John Hamlyn, then my tenant; afterwards, by the kind introduction of the Rev. M. Lowndes, *from nearly the centre of Dartmoor*, by Mr. Barter, of Baredown, about 1260 feet above the level of the sea; *from Thorverton*, on the new red sandstone, from Mr. H. Lowcock, of Raddon Barton, aided most materially by the care and assistance of Mr. Louis Reynolds, his able manager and assistant, to whom I feel deeply obliged; *from Bishopsteignton*, on the greensand formation, by Mr. Grylls, an attentive observer; *from Moulton*, by Mr. Cann. Also from many other places, which if quoted here would extend this paper beyond any reasonable bounds; the result being, that on the cold and tenacious clay, on the granitic soil, on the new red sandstone, on the greensand formation, on the limestone, and on the clay-slate (locally called, *shillity land*), the reply *uniformly* was that *farmyard manure was prejudicial*, and powerfully contributed to the ravages of the disease. *Guano* appeared to be *equally bad*. *Wood-ashes* appeared to be more favourable, as did *tanner's bark* and *heath ashes*. *Fern ashes* caused some disappointment, for, containing so large a proportion of silica, it did not manifest any superiority over the other ashes. All, however, expressed a very decided opinion *as to the great superiority of lime and salt* as the best potato manure.

I shall pass over the numerous experiments made to investigate the action of manures under my own especial observation, and shall merely state the results:—Farmyard manure, rotten, or fresh; gas lime; leather shreds; gas water, with sulphuric acid;

gas water, with nitric acid (the worst of all); nitrate of potass; nitrate of soda;—all gave unfavourable results.

Antiseptic and other chemical manures, such as chloride of lime, iodide of potass, charcoal (fresh) in fine powder, charred sawdust, burnt clay, peat ashes in their usual state, though costly in price, were tried at three separate periods in each year, with only negative results. If they did not render the disease harmless, they did not aggravate it. From the curative success of the flour of sulphur in numerous vineries, and its effect in checking the propagation of the disease in very many greenhouse and conservatory plants, 27 yards of ground were measured out and divided into three beds, each 9 yards long and 1 yard (or pole) wide. Three drills of potatoes ran the whole length in the centre of each compartment; the drills being 30 inches apart, and the sets in the drill 20 inches from each other. Between these drills there were two rows in which cabbage plants were grown. 28 lbs. of flour of sulphur were divided into three equal proportions; and in bed No. 1 this quantity was strewed over the sets when planted in the trench, and then covered over in the usual manner with earth. In bed No. 2, similarly treated, some recently-slaked lime was superadded on the sulphur. In bed No. 3 a peck of lime was mixed with a good quantity of water, and whilst still very hot had the other portion of sulphur stirred up with it; and then, the water being augmented to 9 gallons, one-third portion of the mixture was let run out from the spout of a 3-gallon watering-pot on the sets in the trench, and then all were covered up as before. *The trenches were made about 4 or 5 inches in depth.* These experiments, although varied greatly in detail and on different soils, were very inconclusive, as was 1 cwt. of flour of sulphur sown broadcast over three-quarters of an acre of potatoes as soon as any appearance of the disease was manifest. Neither did any better result appear from mixing 1 cwt. of flour of sulphur with 1 hogshead of recently-slaked lime, and used as before. Nor was the result more conclusive from mixing 28 lbs. of sulphur with a quantity of lime in a cask, filling it up with 90 gallons of water, and drawing off the clear solution, mixing 1 quart of it with a watering-pan not quite full (about 3 gallons) of soft water, and sprinkling it with a coarse rose over a similar quantity of potatoes. Having taken up the idea that a deficiency of soluble silica, which forms the outer coating or envelope of every vegetable production, might prove a very great predisposing cause to the ravages of the disease, and seeing that it was always communicated to the under side of the leaf, *where there is not one-third part of the silica that the upper side of the leaf possesses*, a hundredweight of silicate of potass was obtained from Manchester, and boiled in soft water until the

whole was dissolved; water was then added until the whole filled up a pipe containing 110 gallons, which was watered over the sets as planted in three-quarters of an acre of ground: this was far more encouraging than any other experiment, but was too costly for common use; a modification of it is most valuable, and has been for several years my only manure.

When the disease was at its height and the terror the greatest (in 1847), it was noticed that in a high field directly above the river Dart the stalks of the potatoes had been blown out and fairly drifted away from the ridges over a large portion of the field. A yard (5 paces by 5) being marked out, a man soon collected the stalks. They did not amount to a moderate handful, and did not weigh a pound avoirdupois. Being incinerated, 1000 grains only left a residue of 11½ or 12 grains of silica. Nor have I seen until last year (1856) potato stalks with anything like the usual old mode of growth.

Simultaneously with these experiments, which in fact have been continued up to this present hour, it was determined to ascertain if possible what effect depth of soil might have on the produce of the set, and possibly on the disease. It was remembered that in 1847 and 1848, when the disease appeared to be greatly on the increase, and threatened to be, as it really was, most destructive, a man at Whilborough, on dry days, in order to save his potatoes, instead of digging them up, *made the earth very fine, earthed the stalks up very high, and saved his crop most effectually.* It was also recollected that many years since the late T. A. Knight, of Downton Castle, had advocated a considerable change in the culture of the potato; recommending the cleansing a wheat stubble, and carrying on to it a large dressing of farmyard manure early in the autumn, directly after the removal of the wheat crop; ploughing the ground deeply; thoroughly incorporating the manure with the soil; and planting the potato sets *at a greater depth, the rows or drills much further apart, and the sets in the rows at far greater distances, than ordinarily in use.* Whilst thinking about Knight's plan, and making ineffectual endeavours to find where I had seen his paper, an intimate friend solicited my opinion. He had grown rather more than an acre of potatoes (172 yards), and engaged a man to dig the potatoes at per bag (a bag of potatoes is 7 scores). He paid him for 78 bags. Soon after, walking over the ground, he was astonished at the number of potatoes lying on the surface of the ground, and sending a person to collect them, took away other two bags, making 80 in the whole. In the following April, intending to sow barley in this piece of land, his manservant returned to say that he had found a vast many potatoes coming up, and recommended letting them alone. He did so. The plants were

very irregular ; where they were too thick he had them cut out, and, on mentioning to him my recollections of Knight's distances and plans, he had the plants earthed up many times most abundantly. It is not going too far to say that this piece of ground looked as if studded with bee-hives scattered at random over it. He had such a crop as at that time I had never seen. The following year I endeavoured to follow Knight's plan more exactly. The ground, a wheat stubble, was manured early in the autumn, and the manure was carefully ploughed down ; soon after Christmas it was cross-ploughed, and about the 1st of March it was ploughed very deeply with Locock's patent iron plough; and the beam being loaded, to keep it down, it was found that the shillet had been broken up and brought to the surface, the depth averaging from 9 to 10 inches (this operation is called technically double-ploughing). The trench being now turned out with a spade, the sets were planted 8 inches deep, in rows 3 feet apart, and 20 inches set from set. Whilst this experiment was in progress, Mr. Henry Lowcock, of Raddon Court, Barton, was *double*-ploughing a large steep field, the higher part of which was more than 250 feet above the lower portion—the method being for one plough to follow another in the same furrow, thus turning out a furrow downwards of a very uniform depth of 8 inches; the ploughs being under the management and control of John Talbot, afterwards ploughman to Messrs. Ransome, and doubtless known to many members of the Royal Agricultural Society. He then planted three rows of potatoes from the top to the bottom of the field in a manner similar to that just described.

The results were wondrous, the crop being enormously increased in weight and bulk. *Nor is it a matter of doubt that if land be trenched to the full depth of the spade or fork, or double-ploughed in the manner described, and the plants be early earthed up,* 300 *bags* (*of* 7 *scores to a bag*) *of potatoes is a crop to be, not once, but ordinarily obtained per acre.* Another *and most unexpected result was also obtained,—few or none of the potatoes so grown were diseased.* The potatoes so grown are not only far more numerous than ordinary, they are also increased extraordinarily in bulk, but have the following defects: they are close, frequently have a core, or perhaps a hollow in their centre, surrounded by a thick portion of hard corky substance; and even if sound all through, dress badly. It is true that some sorts of potatoes are greatly more disposed to be hollow or core than others; but, as is well known to every housekeeper, the waste on cooking oversized potatoes is considerable, and they are justly regarded with aversion by the public, so as to be unsaleable at market.

Now it has been stated, p. 74, "that a man at Whilborough,

when the disease was most destructive, earthed the stalks up very high, and saved his crop most effectually;" again, on p. 75, "few or none of the potatoes so grown were diseased." The question then arises, *what is the disease?*

Very numerous and varied replies have been made to this question, many of them unworthy of consideration. If examined with the aid of a powerful lens, the spot appears to be regularly five-sided, angular, with one of the angles considerably protruding beyond the others; the centre is dark brown or black, shading away to a lighter tint towards the confines, which are marked frequently, but not always, by a line deeper in tint than the colour within. The angle projecting is not confined or limited to any one of the five angles. In the mulberry, the leaf being thicker and broader, there frequently are many patches on one leaf, and it can be easily seen that the protruding angle points in diverse directions; in the potato leaf it is rare to find more than 3 patches of disease, but the diverse direction of the angularity is equally perceptible; outside the confines of the patch may be seen numerous vessels filled with a reddish brown appearance, radiating into the sound substance of the leaf, and every here and there apparently anastomose with each other, forming as it were a rayed plexus, around the central spot; if the evenings be moist and chilly the progress of the disease is rapid, it soon reaches the stem, when the leaf droops and soon becomes puckered and shrivels up. If we now look at the centre of the blackened spot, our unassisted eye cannot detect any hole in the texture; but if we hold it between our eye and a vivid light, we shall perceive distinctly a hole. If we now turn the leaf upside down, and examine it with a good glass, we shall find that the edges of the hole are turgid and full, and presently we shall see a fine line, or thread as it were, of silvery whiteness arising from one side of the edge of the hole, and springing over, like a bent bow, to the opposite edge, where it terminates in two little knobs; and it will also be observed that this thread or bright line has its whole edge knobbed or rugose, with similar little knobs thickly arrayed on it. It was at once supposed that these knobs or excrescences were the seeds or germs of the disease, and on the discovery that sulphur in a confined place was a sure and effective remedy, a great many plants grown in pots for the purpose were exposed under favourable circumstances to the action of the blackened portion surrounding the hole with the supposed bloom on it. In a great number of instances the contagion was speedy and certain, and from these plants so infected other sound plants both of the vine and potato were again infected. Neither could the disease again taken from the greenhouse, after undergoing three inoculations, first on

the vine, next on the potato, again on the vine, and then applied to potatoes, vines, and mulberries *in the open air*, be in any way distinguished from *disease produced by natural means in the open air.* It was also remarked in very many experiments, that if the supposed bloom was placed on the *upper part of a leaf under favourable circumstances, it produced no effect on that leaf*, but would infect frequently the leaves above. It is said above that sulphur in a confined place is a sure and effective remedy, yet it fails in the field although greatly diversified in application (see p. 73), nor although closely observed has the cause of the failure been detected; yet it operates remedially in the garden, on the potato, vine, lilium, or verbena, evincing a contradiction not at this moment capable of a satisfactory solution. Failing, then, all chemical remedies when applied on the large scale, and it being certain that the disease in no case ascends from the root but descends from the leaf to the tuber, the experiment at Whilborough (see p. 74) again became important; and it was repeatedly confirmed by the favourable results attendant on the deep planting (see p. 75), and the inquiry now arose, "Can we by any peculiar course of culture save the majority of our crop?" Experiments were at once instituted on a very extensive scale to test this question, and also to ascertain if the same advantages could not be derived without making the potato so inordinately large, and of course unsaleable.

It was observed in taking up many acres of potatoes by many men, that *no potato covered with more than three inches of soil was ever diseased;* and on repeating the experiment with very great care, I felt assured that no potato covered with three inches of soil becomes diseased, and that their experience was correct. Experience has taught me how difficult it is to observe correctly, but no fear need be entertained that this idea can be controverted, and the effect on the crop must be seen to be appreciated; for instead of two-fifths of the entire crop being wasted, as was the case last year (1856), it is rare indeed to find a diseased potato; so rare, in truth, that an attentive examiner will soon detect the cause of that one diseased potato. I have seen scores of bushels of potatoes dug; but I have never seen or heard of one diseased potato *being found four inches under the surface of the ground.* The experiment is easily made: make a deep trench by the side of any row of potatoes, and parallel thereto; then with a trowel or pointed stick take down perpendicularly the soil. *It will be at once seen, and too much stress cannot be laid on the fact, that the disease is in an exact ratio to the proximity of the tubers to the surface.* To elucidate this, on September 18, 1857, three pits were made 10 inches deep, and about the same in diameter.

Three white kidney potatoes were placed horizontally on the bottom, and just covered with a little fine earth; then another layer, similarly covered; and then a third layer; so that the whole consisted of three layers of potatoes, with just earth enough between to keep them from touching each other; and the uppermost layer about 2½ inches under the surface. A few diseased leaves and stems were placed on the surface of pit No. 1; and then watered with half of a small garden-pan of water, with a fine rose; pit No. 2 was watered with the remaining water; pit No. 3 had a large slate put on it.

September 28, No. 1 pit had each of the upper three potatoes slightly affected.

January 23, 1858, No. 1. Three upper potatoes quite rotten.
,, No. 2. Three upper much affected.
,, No. 3. Three upper not diseased.

In all three pits *both the under layers were free from any taint.*

If, then, we endeavour to epitomize the conclusions arrived at, we find that in selecting ground for a potato-patch we should choose the higher part of a field; that the soil should be light and friable, and that no farmyard or nitrogenous manure should be employed. The first ploughing should be deep, early in the autumn, and the piece *brought into earth* soon after Christmas. The manure should be 20 hogsheads of lime per acre, placed conveniently in heaps of one hogshead each. About 14 lbs. of common salt, dissolved in three or four gallons of water, should then be sprinkled from a large-rose watering-pot over each heap, and the whole, made up compactly, should be deeply covered over with earth. In two days it is fit for use, and in practice I prefer throwing it abroad *on the surface just before the plough*, so that it may remain uncovered as short a time as possible; then all being ready, a drill is made and the first row of sets is deposited therein, the depth being about 4 inches, at an average distance of 15 inches set from set; and the one-way or turn-wrest plough being used for the purpose fills in the trench with the *lime and salt on the potato.* The next row should be from 24 to 26 inches from the former, and is covered when planted as before. If the ground is in a fit and proper state of tilth, it presents a level surface when finished; but as soon as the plants appear and the rows *can be seen*, men should be sent to the field with hoes, who from the *middle of the alley* should ridge up the row, gently but completely covering every plant; in a fortnight or three weeks' time the plants will be again two or three inches above the ridge, which is again heaped up from the centre of the alley. Now comes the utility of the information derived from the Whilborough experiment (see p. 74) and the subsequent experience: in June, choosing a fine clear sunny day towards the latter end of that month, I send

a careful man, with a rather long but narrow hoe, to the potato plot, with positive directions that he shall make very fine the middle (only) of the alley, and carefully earth up with the fine earth each ridge, and I go once at least in every day and narrowly inspect each ridge to see that the earthing has been done according to my instructions.

In July it becomes needful to keep a watch on the Lilium lancifolium; the disease appearing on the lilium just three weeks before the potato is affected gives an important warning; and the last earthing having now settled down, a man is sent into the plot with the most earnest injunction that he shall carefully earth up with the finest earth every ridge and every plant in the ridge. It will be found in digging that few are diseased, and those few admit of an easy explanation why they are affected. It will also be found that white potatoes are less affected, all things being equal, than the particoloured or red, and these are also less diseased than the purple or black skinned potatoes. It will also be found that the earlier a potato arrives at maturity, the less probability is there that it will become diseased; and this has been abundantly proved during the last four seasons, but especially in the last, pronounced by every one to be the worst since 1846. Out of above 30 bags of the variety called the 'Early Fop,' I had not one peck of diseased potatoes among the entire lot.

Again, the White Kidney.—I was favoured by Mr. Moore, of Torquay, with a basketful of this excellent variety. The basket and potatoes, straw included, weighed a trifle more than 53 lbs. They were treated as directed; the produce was *six sacks and about half a basketful.* The diseased potatoes in this lot amounted to rather more than a peck and a-half, the disease being confined to one end, where, despite all the care taken, they were *too near the surface.*

One other sort was grown, the York Regent, part of the seed being of my own growth, and the remainder obtained from the Lothians. Both were equally good, but the latter were rather the latest. Three bags were employed as seed; the produce was sixteen and a-half sacks; the diseased potatoes averaging not quite three-quarters of a basketful.

Well, then, the sorts recommended as being most excellent in quality and productive in quantity are the Early Fop, the White Kidney, and the York Regent. The Early Fop was planted whole, the Regent cut into halves, the White Kidney into six or eight sets.

Of seedlings some hundreds have been tried, and many have attained under a multitude of names some local celebrity. But they are not possessed of any immunity against the attacks of

the disease, and as they rarely manifest their real qualities until the end of the third season from sowing, and require much care and attention, the culture of potato seedlings has for the last two or three years sensibly declined in public estimation.

In conclusion I feel bound to say that I am not in any way wedded or bound to any one opinion. I am an inquirer in the strictest sense of the term; but when it is considered that I grew last year (1856) and the year before rather more than 70 bags of potatoes in each year (of 7 scores each), and that in the two years I had not a sackful of diseased potatoes, I hope that I shall not be deemed intrusive in soliciting the attention of the Royal Agricultural Society to these facts, and trust that under their auspices many will be induced to repeat my experiments with equally favourable results.

Early in July, 1857, it became necessary for me to go from Exeter to Truro, in Cornwall, and I eagerly embraced every opportunity of hearing about and personally inspecting the progress of the disease. Near Exeter the disease was everywhere appearing, but did not excite much apprehension; from Plymouth downwards the alarm was general, and every one was getting up his crop with the utmost expedition. The road from Torpoint, leading through the grounds which mainly supply the markets, afforded an excellent opportunity of settling the question, "Does the disease spring from the root-stalk, or descend thereto?" After passing by many potato fields we came to a large field where eleven men in a row were digging potatoes, with two others assisting them—thirteen in all. There was not a sound potato-leaf in the field; and in many instances the disease appeared on the stalks. I inquired of the proprietor, "Why are you in such a hurry to get up your potatoes?" "Because the disease would be washed down to the potato by the first rain." "Then you have not had rain lately?" "No; it has been very calm—no wind—no rain—but *much dew;* ten days ago, I hardly saw a sign; now I never saw the disease worse." I saw them dig up some hundreds of stalks, quite free from disease below the surface, and then said to the grower, "It has not affected the lower portion of the stalk, nor the potato as yet." "No, Sir," he replied, "not as yet; but three or four days after the first rain, look sharp." I should observe that "local fog," universally so destructive, was out of the question in this field. When we left Plymouth the price of potatoes per score was 16*d.*; seven days after it was 9*d.*

I returned, I confess, with some misgivings, for since 1845 the disease had never been so rife; but my faith in lime and salt as manure was strong; my faith in fine earth well kept up around the stalks, as a certain preventive to the descent of the disease, was still stronger; and I knew that no nitrogenous com-

pound had been used—yet I felt doubts. My misgivings were unfounded. There were not a hundred affected leaves in the field, and although the rooks gave me much trouble, yet I succeeded at much cost of labour in keeping up the fine earth well around the stalks; and my exertions were rewarded; for on digging up the crop in the middle of September (I finished on the 18th) there was not a diseased potato.

The conclusions from all these observations are:—That the disease is of a fungoid nature, increased in virulency by atmospheric causes. That all manures are injurious, saving only lime and salt. That the earliest potatoes in ripening should be exclusively grown. That earthing up repeatedly with fine earth is the only effectual preventive to the ravages of the disease.

The Elms, Ipplepen, Newton-Abbot.

III.—*Observations on the Anatomy and Physiology of the Mammary Gland of the Cow, with the Causes influencing the amount of its Secretion.* By James Beart Simonds, Professor of Cattle Pathology at the Royal Veterinary College.

The proper management of Dairy Cattle is a subject which deeply interests the major part of the agricultural community, and as such it has led to the publication of the details of various systems, in which we may observe that great discrepancies are found to exist in the opinions of the several authors. Not only is this the case with regard to the treatment of the animals themselves, but an equal difference is to be observed with reference to the kind of animal best calculated for dairy purposes. Much of this is often to be traced to the preconceived notions of the writer, and to the prejudice which obtains in favour of a particular breed in his own locality; while it is evident that the true value of each individual animal is due not merely to its capability of yielding a large supply of milk, but also to this fluid being rich in the elements of butter, cheese, &c., or in those of the development and growth of the young animal. It is not, however, our province in the following paper to discuss the respective merits of the several dairy systems which prevail, nor the relative value of the Long-horn or Short-horn, the Devon or Hereford, the Ayrshire or Suffolk, the Alderney or Kerry, as milking animals; but to describe the *structure* and *function* of that part of the organism on which the secretion of milk depends, and also the *causes* which influence—beneficially or otherwise—the *quality* as well as the *quantity* which is produced.

In directing attention to these divisions of our subject we may remark that it is our intention to speak, *firstly*, in general terms

of the mammary gland, as developed in some other animals besides those of the Ox tribe, as thereby a better illustration will be afforded of the precise arrangement of its component parts in the cow.

The mere existence of these glands shows that the creature which possesses them belongs to the higher order of animated nature, no matter what may be its size or form, the character of its food, the region it inhabits, or the medium in which it lives. Mammalian animals, so called from *mamma*, a teat, have consequently certain properties which are common to them all; thus, not only have they an internal skeleton, the spine of which is composed of different segments—*vertebræ*—constituting them vertebrated creatures, in contradistinction to others that have no such skeleton—the *invertebrata*—but they are likewise warm-blooded, have blood of a red colour and a double circulation. They also breathe atmospheric air, possessing for this purpose lungs which aërify their blood for the maintenance of vitality; their bodies for the most part are covered with hair or wool, and their young are developed in an internal organ—the womb—and when brought forth are nourished for a time by the secretion afforded by the mammary glands of the parent, until they are old enough to seek their own food or have it supplied through other sources.

Without entering into the subject of the classification of mammalian animals, or the rules appertaining thereto, it will be sufficient for our purpose to observe that each is admirably adapted, by a modification of its several organs, for the position it has to occupy, as well as for the obtainment of the food on which it has to subsist. By far the greater part of mammals are designed to be inhabitants of the land; not a few, however, dwell in the water, and some may be said to occupy the air. Examples of the two latter are to be found in whales, dolphins, porpoises, &c., which dwell in the mighty deep; and in bats, those winged creatures that flit through the dusky air. Of the dolphins it has been said that the female brings forth but a single one at a birth, which she nurses and suckles with the greatest care. Bell, in his admirable work on British Quadrupeds, writes that "the mammary glands of the dolphin at the period of birth become enlarged, and the teats exserted: the young one seizes the teat with its lips, and the mother lies in some degree on one side in order to enable both herself and her young one to respire whilst the operation of suckling is going on." The same author likewise, when speaking of the peculiarities of bats, says that "the female bat brings forth one or two at a birth, which she nurses with great tenderness and care, carrying it about with her, and holding it enshrouded in her ample cloak, which preserves it from all

intrusion." Thus we see that the same laws obtain with regard to these creatures as are in force with reference to terrestrial mammals.

It will be apparent from the preceding remarks that the mammary glands belong to the reproductive system, and are to be viewed as most important auxiliaries of the generative organs. Placed as a general rule as much as possible in a situation of security, and one also of easy access to the young animal, these glands will nevertheless be found to vary considerably in their location, and even so among our domesticated animals. In the mare, cow, ewe, and goat, they are situated far back on the under surface of the abdomen—the pubic region of the anatomist,—and are here securely protected from injury on either side by the hind limbs. In the pig, bitch, and cat, on the contrary, they are arranged in two rows, on either side of the medium line of the abdomen, and extend from the pubic region behind to the pectoral region, or breast, in front. In the human subject it is well known that the mammæ occupy the pectoral region, and the same is the case with the quadrumana, also with the elephant, and several other creatures.

As both secretion and development depend on the freedom of the supply of blood to the part, so it is found that in many instances the same organs in animals of different classes obtain their blood from vessels which are identical in their origin with those in creatures from which they themselves differ. It is evident, however, from the great variation which exists in the position of the mammæ among domesticated animals, that these organs not only receive their blood from different vessels, both according and near to their location, but that they return also as much of it as is unappropriated back to the heart through contiguous venous canals, which are unused for such a purpose in other animals. These anatomical facts, although not properly belonging to the subject we have principally to treat of, are nevertheless necessary to be mentioned for the better elucidation of the peculiarities attaching to the mammary glands of the cow.

From the foregoing observations it will be inferred that the number of the mammæ is subject to great variation. In the mare, the ewe, and the goat, we find two; in the cow four, or occasionally six, the two additional ones being generally but imperfectly developed; in the bitch ten or twelve, and in the pig often as many as sixteen or eighteen. To some extent their number affords an index to the quantity of young animals which may be produced at a birth, but not, we think, sufficiently so for it to constitute a rule. For example, in the selection of multiparous animals for breeding, care is usually taken to choose such as possess a large number of mammæ; but how often do we find that

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a sow with sixteen or even eighteen will only bring forth five or six young ones! Nevertheless, it is highly important for success in breeding that the largest number of young should be amply provided for, or many will be lost for want of sufficient nourishment obtainable from their parent.

Even with the cow the existence of *four* mammary glands may be taken as evidence that this animal could rear an equal number of calves, if perchance so many should be brought forth at a birth. Indeed it is a practice with some persons on dairy farms to place *four* calves, which are intended for weaning, upon a cow very shortly after she has been delivered, and to allow them access to her morning and evening. Within a week or two these young animals will, in the interim between their sucking, begin to take a little meal, oil-cake, or soft hay, and also to sip some hay-tea; and by the time they are ten or twelve weeks old, they are frequently fit to be entirely removed from the cow. Their place is then supplied by two or three others, depending on the quantity of milk yielded by the animal, and these are managed precisely in the same way until they also can be taken away. Again a third lot of two or three are dealt with in the same manner. In this way ten calves can be weaned within a few months from one cow; and we are familiar with an instance of forty calves having been thus reared, by an agriculturist of high reputation, from four cows within the past year. It is a practice also which we ourselves have recently adopted, and with perfect success. With such facts before us, it cannot be questioned that in a state of nature as well as in domestication, a cow could sufficiently provide for the sustenance of four young ones, and this because, as has been stated, she has four distinct mammary glands.

Notwithstanding the diversity which obtains both with regard to the number and position of the mammæ, the secretion of milk is effected in the same manner in all animals. The milk ducts, however, as well as other structures which enter into the composition of these glands, are liable to vary as to the precise manner of their arrangement in different classes of animals. Thus we find that in graminivorous, and particularly in ruminant animals, the lactiferous ducts in their course towards the teat dilate into pouches, capable of containing several ounces of milk, to which the term of reservoirs has been applied. On laying open a gland of this description, these receptacles give an appearance of the organ being chiefly made up of a cell-like structure, the walls of which are seemingly formed of condensed areolar tissue of varying thickness, but which in reality are found, on close investigation, to consist principally of small lactiferous ducts. In the subjoined engraving, which represents a vertical section of

the mammary gland of the ewe, these reservoirs are well shown (see *a*, *a*, *a*). The intermediate and light-coloured portions (see *b*, *b*, *b*) represent also the tubular structure alluded to. The entire figure tends to convey a fair idea of the form of the gland, together with its appendage the teat.

Fig. 1.

Vertical section of the mammary gland of the ewe, showing the milk reservoirs, the teat, and the opening of the duct through which the milk passes; *a*, *a*, *a*, the reservoirs; *b*, *b*, *b*, the lactiferous tubes, appearing as condensed tissue; *c*, the teat; *d*, the opening of the mammillary duct. (After Sir A. Cooper.)

Without describing in a more exact manner, in this part of our essay, the arrangement of the several parts of the mamma, we may state that in the carnivorous and likewise in the omnivorous classes no reservoirs properly so called exist, provision being made for the retention of the milk by numerous but small dilations of the coats of the lactiferous tubes themselves, and by the several windings which they form in their course—anatomical peculiarities which are depicted in Fig. 2.

It is perhaps right that we should here offer an explanation of our having refrained in general from using the common term udder, even in alluding to the cow. The adoption of this name would, we consider, be likely to lead to wrong inferences. Many persons might suppose it to be synonymous with the term mamma, and hence infer that only one of these glands existed in the cow, being divided into four segments. We have already spoken of the four *glands* of this animal, and it now becomes necessary to state that these are as separate and distinct from each other as if they had been placed at a considerable distance apart. Clustered together, as we find them, they constitute "the udder."

This perfect and complete isolation of the mammæ is a wise provision of nature, for should one, two, or even three become affected with disease and lose their power of secreting milk, the remaining gland or glands would still furnish a sufficiency of this fluid to maintain *at least the vitality* of the offspring. The separation of the one gland from the other is effected by a reflection of fibrous tissue coming off from the walls of the abdomen, and dipping as a *septum* between them. The same tissue, also, is continued as a covering to each gland, and thus binds the whole of them together. This arrangement places the entire udder in a kind of sling, and maintains its close connexion with the abdominal parietes. In many aged cows the external reflection of fibrous tissue, from having been long kept on the stretch, loses some of its suspending power, and hence in such animals the udder is often very loose and pendulous, occasionally hanging in consequence to within a few inches of the ground—a state of things which is irremediable.

Our admiration of nature's provisions for furnishing a portion of good milk in certain diseased states of the mamma is, however, greatly increased when we investigate the arrangement of the component parts in such domesticated animals as the elephant, the bitch, or the pig. Here it will be found that several sets of lactiferous ducts go to make up the substance of the gland, and that every one of these is as distinct from the other as it is possible to conceive. For a knowledge of this fact we are chiefly indebted to the researches of the late Sir Astley Cooper, who, in his admirable work on the 'Anatomy of the Breast,' gives

several illustrations, showing that the different sets of tubes, when filled with various coloured injections, have in no way commingled with each other. In all animals, therefore, in which such a conformation exists, partial destruction of a gland can occur, and the unaffected portions still continue their secreting functions. The accompanying woodcut, Fig. 2, will exemplify this peculiarity; the different sets of tubes being marked con-

Fig. 2.

Illustrates the lactiferous tubes, as arranged in those animals which do not possess proper milk reservoirs, and in which several distinct ducts pass through the teats to external outlets. The numerals, 1, 2, 3, 4, 5, 6, 7, 8, 9, indicate separate sets of tubes in the substance of the mammæ, which are dilated here and there, and curved in various directions for the retention of the milk. (After Sir A. Cooper.)

secutively with the numerals 1, 2, 3, &c. This illustration also shows the manner in which the milk tubes are curved in their course, and dilated here and there for the retention of the fluid until the wants of the young animal cause its withdrawal in the act of sucking.

Besides this peculiarity we find another which is necessarily connected with the arrangement of the lactiferous ducts that we have described, namely, the existence of several passages in the teat itself for the escape of the milk. It is necessary, for an easy comprehension of this matter, to explain that the latter are anatomically designated mammillary tubes, and that their number is liable to great variation; thus in the elephant and also in the bitch we often find as many as nine or ten, there being a corresponding number of distinct sets of lactiferous ducts, in the substance of the gland; but in the pig rarely more than two mammillary tubes are met with. Evidence of this fact is afforded by the simple act of pressing the teat, when the milk will be found to escape from a greater or less number of points, each being in reality the opening of a mammillary tube. In the mare also two, or occasionally three, of these tubes exist; but in the cow and ewe only one. The tube in these latter named animals is of large size, and capable of giving passage to a copious stream of milk (see Fig. 6).

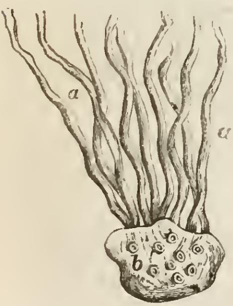


Fig. 3.

Shows the mammillary tubes (a, a) of the elephant, dissected from out of the substance of the teat. It also depicts the openings of these tubes (b), in the skin covering the ends of the teat. An analogous arrangement of the tubes is met with in the bitch.

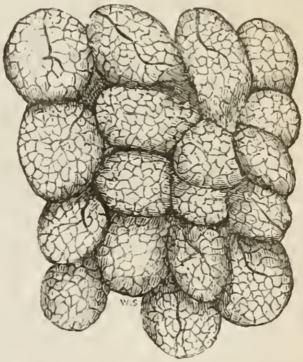
The illustration, Fig. 3, which we here insert, represents a number of mammillary tubes, dissected from out of the teat, but still kept together at their terminal portions by the common integument at the extremity of the teat, where also their openings are shown.

We come now to speak more in detail of the intimate structure of the mammæ, and particularly in the cow. The secretion of milk forms no exception to the rule which obtains with reference to animal products in general, namely, that it is formed from arterial blood. So large an amount of milk as is well known to be furnished within a few hours by the cow, necessarily requires a

corresponding quantity of blood for its secretion. We find, therefore, that the arteries going to the udder are both large and numerous; and that the branches of each vessel freely anastomose together, so that no interruption to the regularity of the supply of blood to every part of the gland may take place. The anterior portions of the mammæ receive their blood chiefly from *the internal pectoral arteries*, which quitting the chest run in a backward course to reach the glands. The posterior parts are supplied principally by branches, called the mammary arteries, which come off from *the epigastric artery.* In addition to these *the circumflex artery of the ileum* sends numerous branches to the glands, which likewise freely anastomose with the other vessels. The several vessels which come off from these trunks penetrate into the substance of the mammæ, within which they freely ramify by numerous divisions and subdivisions. Ultimately, by further splittings up and consequent diminution of their calibre, they form vessels so minute as to be unobservable to the naked eye, and which have been designated *capillaries.* These are distributed to the follicles or cœcal extremities of the lactiferous ducts, upon which they form a minute *rete* of vessels, and furnish blood both in sufficient quantity and also in a condition fitted for the secretion of milk. The annexed woodcut, Fig. 4, represents the cœcal extremities

Fig. 4.

A highly-magnified view of the cœcal extremities or follicles of the lactiferous ducts, in which the secretion of milk takes place. The dark lines, which form a net-like structure on these vesicular bodies, represent the capillary vessels by which the blood is distributed for the secretion.



of the lactiferous ducts, highly magnified, and surrounded by their net-like structure of capillaries. From the cœcal extremities the milk, as quickly as it is formed, finds its way along the minute excretory ducts to which they are attached, into larger tubes, and thence into various-sized cavities which are termed reservoirs. The arrangement of this portion of the gland may be compared to bunches of currants as connected with or growing upon their foot-stalks. The fruit would here represent the milk-secreting follicles, and the stalks the tubes by which it was conveyed

away. Fig. 5 is inserted in order to convey a clear idea of this structure. The lactiferous or excretory ducts are here marked, *a*,

Fig. 5.

Arrangement of the milk-secreting follicles and lactiferous or excretory ducts: *a*, an excretory duct with its several branches, around which are clustered, *b*, the secreting follicles or cœcal extremities of the ducts. (Magnified.)

and the milk-secreting follicles, *b*. From the smaller-sized reservoirs, which are shown both in Figs. 1 and 6, the milk passes through numerous canals into the large reservoir of the gland, which is situated just above the teat (see Fig. 6). Here it is detained in considerable quantity, often to the extent of two or more quarts, until drawn off by the sucking of the calf or by the act of milking, which not only empties the large but likewise all the other reservoirs and milk-ducts. It will thus be seen that by the arrangement of the component parts of the mammæ, provision is made not merely for the secretion but for the *retention* of a large quantity of milk; the glands of the cow, ewe, and goat differing with regard to the existence of these receptacles, as has been elsewhere stated, from those of other domesticated animals.

In Fig. 6, which represents the udder of the cow stripped of the skin, its vessels injected, &c., one of the anterior glands is laid open to show the large reservoir, *a*. The end of a probe is depicted as being passed into it, having been carried upwards through the duct in the teat. *b*, *b*, represent the smaller reservoirs, some of which are opening into the large one; and *c*, *c*, show the lobulated condition of the external portion of the posterior glands, which is produced by collections of lactiferous ducts.

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Fig. 6 gives a view of the udder of the cow after being stripped of the skin which covers it. The vessels are represented as being filled with injection, and one of the anterior glands has also been cut open, in order to expose the large reservoir in its interior, into which a tube is passed through the passage in the teat: *a*, the reservoir; *b*, smaller reservoirs; *c*, the outer surface of the posterior glands, which have a lobulated condition, produced by bundles of milk-tubes collected together; *d*, the mammary veins; *e*, the origin of the superficial abdominal vein, commonly called the milk-vein. (Modified from the plate by Sir A. Cooper.)

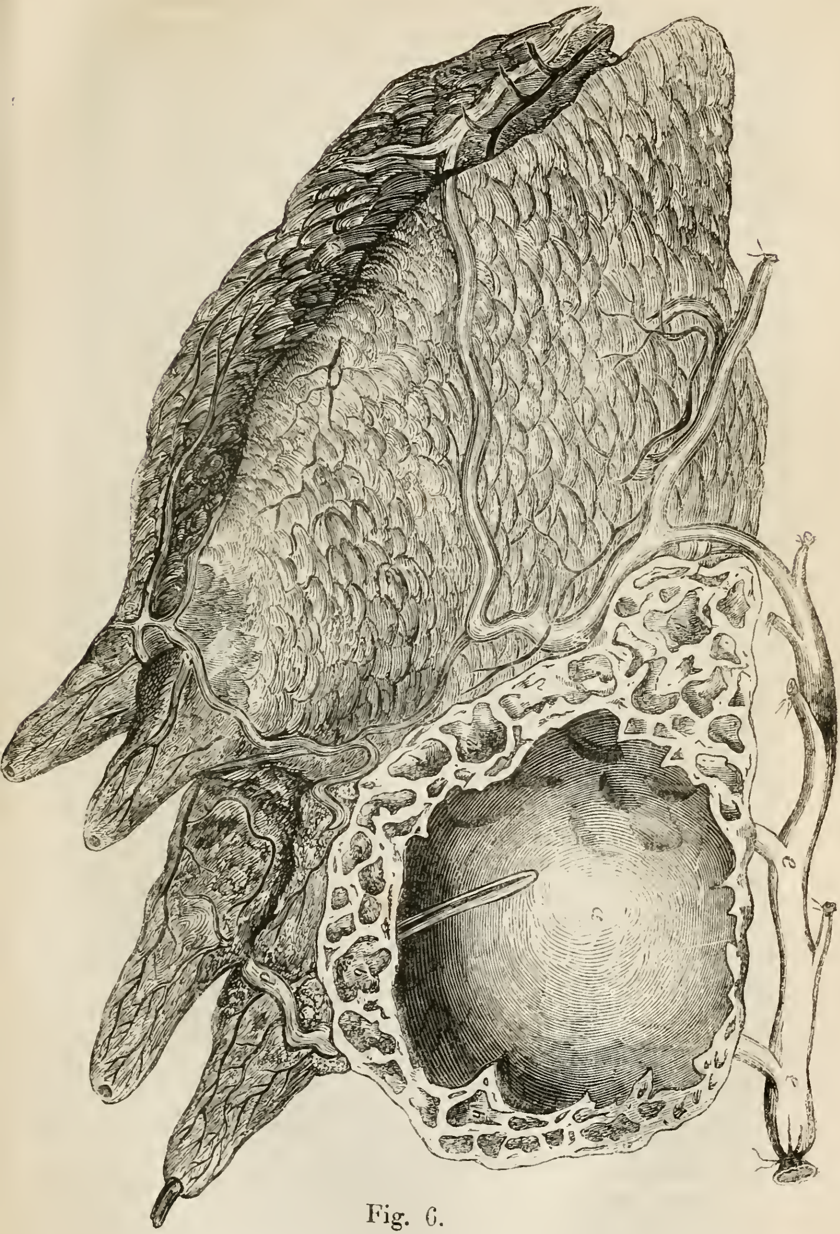

Fig. 6.

We come now to speak of the veins of the mammæ, which are likewise shown in Fig. 6, *d*, *d*, and *e*, *e*. These are very numerous and large, it being necessary that every facility should be given for the return into the system of the blood which has not been appropriated for the secretion of milk or for the maintenance of the integrity of the glands. Taking their rise chiefly from the capillary network of the milk follicles, the small venules coalesce to form distinct branches of veins—the mammary veins. Many of these pursue a course towards the upper and back part of the udder, while others proceed towards the upper and front part of it, for the purpose of carrying the blood into large vessels which are met with in both these situations. The veins which pass backwards empty themselves into the inguinal, and these in turn into the iliac veins, by which this portion of the blood is returned to the heart through the *posterior vena cava.* Those on the contrary which proceed forward convey the blood into large vessels—the superficial abdominal veins—commonly known as the milk veins, and by them it is transmitted into the internal pectoral veins, reaching the heart by means of the *anterior vena cava.* The size of the superficial abdominal vein (see *e*, Fig. 6) on either side of the belly, sufficiently indicates that the greater part of the blood coming from the udder passes through them. Notwithstanding, however, the position which these vessels hold with regard to the mammæ, and the common opinion which assigns a value to them as an indication of the milking properties of the cow, Mr. Youatt, in his work on Cattle, describes them as belonging principally to the chest, or, as he says, "to the respiratory system more than to any other." * Quoting from Girard's Anatomy, he gives an elaborate account of the origin, course, and distribution of the superficial abdominal vein, and absolutely by this reverses the course of the current of blood within it, describing the fluid as flowing in the opposite direction from that which it really does. Further on he censures the veterinary surgeon who should open this vein in treating diseases of the mammæ, by remarking that "if we were to have recourse to bleeding from this vein in garget, or any inflammatory affection of the udder, we should betray our ignorance of anatomy." It is very remarkable that such an error as this should have crept into the writings of one so deservedly estimated as an authority on veterinary science, and our only object in alluding to it is to set the agriculturist right with regard to the true office of the superficial abdominal veins, and the propriety of taking blood from them in cases of inflammation of the mammary glands.

To this description of the arteries and veins of the udder, we

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* Cattle, page 349.

may add that the organ receives a full supply of nervous filaments from the lumbar plexus, which by their union with the nerves of organic life, otherwise designated the ganglionic or sympathetic system, provide for the special office of secretion as well as the endowment of ordinary sensation. It is, however, unnecessary that we should enter into any particulars of the course and distribution of the nerves, or of the absorbents which belong to the mammæ, and which likewise freely ramify in their substance. We shall close our description of the anatomy of these glands by a few remarks on the structure of the teats.

The teats are four in number, or occasionally six, two being superadded in connexion with additional mammary glands which exist in some cows, but which as a general rule are imperfectly developed, and as such do not yield any supply of milk. The teats are all of them directed more or less forwards and outwards, so as to be conveniently placed for being seized by the calf when sucking. This position is best seen in a heifer at the time of her first calving, because from the subsequent long milking of the animal the teats are often drawn into a position more directly downwards; a state of things well observed in old cows. In point of size they vary a little, the two anterior ones exceeding somewhat the dimensions of the two posterior.

Each teat, as has been previously stated, is perforated by a duct which communicates above with the milk reservoir, and is capable of giving exit to a copious stream of the fluid. This mammillary duct is lined by a vascular mucous membrane, which has a thin covering on its exposed surface of tessellated epithelium to defend it from injury. The same membrane is continued into the reservoirs and lactiferous *tubes* lining them throughout; but in the smallest ramifications of these, and also in their cœcal extremities, where the secretion of milk is effected, the epithelium is modified into cells. Externally to the mucous membrane both fibrous and yellow elastic tissue are met with, which by their free interlacings make up the chief wall of the mammillary duct, and give strength and elasticity to it. At the terminal portion of the duct these tissues are developed in increased quantity, and thereby restrict the opening so that no milk can escape from the teat, unless pressure is imparted from above to overcome this resistance. A want of sufficient development of fibrous tissue at the end of the teat, or a loss of its firmness of texture in some cows, becomes a cause of the animal losing her milk when the reservoirs and ducts are filled with the fluid. Various expedients are had recourse to to remedy this state of things, but none can be said to be attended with perfect success.

Externally the teats are covered with the common integument, which is here without hair, and is also very thin and pliable and thrown into wrinkles. Between the skin and the true fibrous coat

of the duct, both contractile and areolar tissue are developed; the latter forming a bond of union, in which numerous bloodvessels ramify.

Such are the chief points of interest in the anatomy of the mammary gland and its appendage, the teat, and having described these we proceed to speak of the secretion of milk.

The Milk.

The colour and general condition of this fluid are so well known that it is unnecessary to enter into any particulars respecting them. Of all the secretions which are elaborated from the blood, there are none which come so near to it in chemical composition as milk. This circumstance, however, ceases to be a matter of any surprise when we come to reflect on the fact that milk is the sole nutriment of the young animal, both immediately after, and for several weeks succeeding, its birth. Indeed, milk may be said to be but blood in another form. Dr. Abernethy used to remark that it was "*the most nutritious of all things*," and in the language of Prout we may say, that it is "*the true type of all food.*" On this point Dr. Carpenter, in his 'Manual of Physiology,' has wisely expressed himself by observing that milk being "an admixture of albuminous, saccharine, and oleaginous substances, indicates the intention of the Creator that all these should be employed as components of the ordinary diet." Besides this mixture of nitrogenous and non-nitrogenous matters, so essential to the maintenance of life, the saline or inorganic matters also which milk contains are no less necessary to the growth or development of the young animal. These also are nearly identical with those of blood, with a greater proportion, however, of the phosphates of lime and magnesia—salts, especially the former, which enter largely into the composition of bones.

The albuminous portion of milk is met with in the form of *caseine*, which is held in a state of solution in the water of the fluid, as are also the salts and saccharine matters. The oleaginous substances, on the contrary, exist in the form of globules, which are rendered visible by the microscope, and when the fluid is thus examined they are found to be floating freely in it, without any tendency to coalesce or run together. Fig. 7, which we here insert, gives the ordinary appearance of healthy milk, when examined by a highly-magnifying power. It will be seen that the globules vary considerably in size, some existing in the form of mere points, while many of the larger attain a size of $\frac{1}{2000}$th of an inch, their average dimensions being $\frac{1}{4000}$th of an inch. In proportion as milk is rich in butter, so are the globules present in increased number and size. The colour and opacity of milk are both due

to their presence. Possessing a less specific gravity than the fluid in which they float, they rise to the surface of milk kept at rest, constituting the cream.

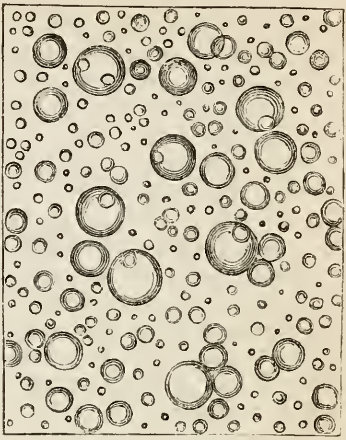

Fig. 7.

The microscopical appearance of the milk globules—the oleaginous portion of the fluid. These bodies vary considerably in size, as is shown by the figure; some existing as mere points, and others measuring about $\frac{1}{2000}$th of an inch in diameter. They exist in increased or diminished numbers in proportion as milk is rich or poor. They do not coalesce in healthy milk, being apparently surrounded by a thin covering of insoluble matter, which keeps them asunder.

Dr. Carpenter thus writes: "If it (milk) be allowed to stand for some time exposed to the air, a large part of the oleaginous globules come to the surface, in consequence of their inferior specific gravity, and thus is formed the *cream*, which includes also a considerable amount of caseine with the sugar and salts of the milk. These may be partly separated by the continued agitation of the cream, as in the process of churning; this, by rupturing the envelopes of the oil-globules, separates it into *butter*, formed by their aggregation, and *buttermilk*, containing the caseine, sugar, &c. A considerable quantity of caseine is still entangled with the oleaginous matter, and this has a tendency to decompose, so as to render the butter rancid. It may be separated by keeping the butter melted at a temperature of 180°, when it will fall to the bottom, leaving the butter pure, and much less liable to change; an operation which is commonly known as the clarifying of butter. The milk, after the cream has been removed, still contains the greater part of the caseine and sugar. If it be kept long enough a spontaneous change takes place in its composition, an incipient change in the caseine being the cause of the conversion of the sugar into lactic acid; and this coagulating the caseine, by precipitating it in small flakes. The same precipitation may be accomplished at any time by the agency of various acids, especially the acetic, which does not act upon albumen; but caseine cannot be coagulated like albumen by heat alone.

"The most complete coagulation of caseine is effected by the agency of the dried stomach of the calf, known as *rennet;* which

exerts so powerful an influence as to coagulate the caseine of 1800 times its weight in milk. It is thus that, in the making of cheese, the curd is separated from the *whey;* the former consisting chiefly of caseine, whilst the latter contains a large proportion of the saline and saccharine matter which entered into the original composition of the milk."

The chemical composition of milk at once shows that its quality will vary considerably with the character of the food on which the animal is fed, being rich in proportion as this contains *nitrogenous* as well as oleaginous and saccharine matters, or substances nearly allied to the latter, such as starch, gum, &c. The animal machine is, however, not to be viewed as a mere chemical laboratory, for vitality plays fully as important a part as chemistry in the elaboration of all secretions. Food, whether fluid or solid, must first be converted into living blood before ministering to the wants of the system; and when we see that milk is so closely allied to the blood, from which it is produced, we cease to feel surprise that a generous and highly nitrogenised diet should give a like condition of the milk.

We now come to a consideration of

The causes which influence, beneficially or otherwise, the quality or quantity of milk which is secreted.

Many cows, as is well known, are celebrated for their milking properties, while others, on the contrary, yield but a scanty supply of the fluid. An investigation of the particular causes in operation to effect this leads us to place among the modifying influences—

1*st*, *Breed.*—The Alderney, the Ayrshire, the Holderness, the Kerry, and the Suffolk, are the breeds which, upon the whole, supply us with the greatest number of good milking cows.* Bad milkers may be said to be the exceptions to the rule which obtains with regard to these races. There are, doubtless, many superior milking animals to be met with in our more cultivated breeds of Short-horn, Hereford and Devon, as likewise in others which hitherto have received but little public attention; but we fear these must be regarded as exceptions rather than otherwise.

It does not, however, follow as a matter of necessity that a cow which yields a large quantity of milk shall be the best butter-making animal, for it frequently occurs that such milk has an increased proportion of water and caseine, and is therefore

* The Ayrshire may be considered the true type of a milch cow for the production of *quantity*, and the Alderney for the production of *quality* of milk. The Holderness, or more properly speaking, the Yorkshire cow, is a large-framed animal, which, though generally a deep milker, has a great inclination to fatten when not giving milk, and does not, to the same extent as the other two breeds, bear the sole character and appearance of a milk-making-machine.—H. S. Thompson.

relatively deficient in oleaginous matters. Hence the practical remark that "*quantity* for cheese-making, and *quality* for butter" is what we require. These two things are certainly sometimes combined, as we see occasionally among Alderneys, and when present we can only attribute it to a peculiarity of the organism of the individual animal. This peculiarity, like many others, may and indeed is very likely to prove hereditary, and as such the calves of these animals should be selected for rearing.

The goodness of milk for butter-making is frequently judged of by its colour, preference being given to such as has a yellowish hue. This, however, may be fallacious; for thir colour often depends on other causes rather than on an augmentation of the proportion of oleaginous matter. An Alderney is not unfrequently kept in a dairy, in order to give a greater depth of colour to the butter. Her doing so is due to the excess of yellow pigment which exists in her organism, and which is cast out with the secretion of milk in common with many other vital functions. She, indeed, may be abstractedly a deficient butter-making animal, her milk not being rich in the amount of its oleaginous materials. This augmentation of yellow pigment belongs to the race; it is a peculiarity attaching to their organization, and cannot be explained by the physiologist with any greater satisfaction than can the varied hues met with in man. The fact of its belonging to the race proves it to be hereditary, and its conveyance from parent to offspring is on a par with the transmission in like manner of the capability of giving either a large quantity, good quality, or both, of milk.

From what we have said it will be inferred that we look to peculiarity of organization rather than to mere external development as the cause of certain breeds of animals being good milkers, and to a propagation of this in their natural increase. In asserting this, we would not, however, have it inferred that we attach no importance to external conformation, for we are well aware of its utility in judging of a milking animal. Large mammary glands, possessing symmetrical proportions, and a well-defined outline; depth of flank, and well-developed hind quarters, so as to give an appearance of smallness to the chest, but which in reality is but comparative; full-sized abdominal and other veins belonging to the udder; neat head; bland countenance; light neck; little fat; thin, pliant, and yellow skin; sleek coat, &c.; have all a value, as so many indications of the animal's peculiarity of organization, and many of these things are met with in the breeds we have named as the chief of our milkers.

2ndly, Parturition.—Taking for illustration a heifer in calf for the first time, we observe that during the latter period of

pregnancy the mammary glands are gradually increasing in size, arising from a greater flow of blood to them, and a consequent augmentation in the calibre of their bloodvessels and lactiferous ducts. As the period of parturition approaches, they are so much enlarged as to have acquired nearly their fullest dimensions. The skin is also tense, red, and hot. At the time of calving a fluid can be drawn from the teats which has many of the properties of milk, but differs from it in colour, being of a brownish-yellow hue, and possessing also a thicker consistence. Within a few days this colour and increased viscocity have disappeared, and true milk is now present. The glands are perhaps as large or even larger than they were at the time of parturition; but the heat, redness, and tense condition of the skin have subsided: in short, the full secretive power of the mammæ is established, and the increased quantity of blood on which these symptoms depended is now consumed in the formation of milk.

From this period the animal daily yields her wonted supply until the time of her having a second calf is drawing near, when the quantity gradually diminishes, and on the mere suspension of the act of milking passes entirely away. Her second delivery is accompanied with the same train of symptoms, which are also associated with the production of a peculiar fluid by the mammæ, preceding by two or three days the secretion of pure milk. Again, as her third delivery approaches, the milk lessens in quantity, ceasing ultimately to be produced as before. These phenomena are repeated with each calving, and they show how much the quantity of milk which is yielded by an animal is governed by the states of pregnancy and parturition.

The fluid which we have spoken of as appearing in the udder at the time of each successive delivery is called *colostrum.* Microscopically examined it is found that in addition to the ordinary milk globules, granular corpuscles of a pale yellow colour are present in great abundance. They are much larger than the true milk globules, measuring from $\frac{1}{2000}$th to $\frac{1}{800}$th of an inch. (See Fig. 8, A, A.) The existence of these granular cells imparts a purgative action to the fluid, which is generally viewed as being of great use in assisting in the expulsion of the *meconium* from the intestines of the young animal. This peculiar substance accumulates in considerable quantity in the intestinal canal during the latter period of *utero-gestation;* and it would appear that after birth the stimulating or cathartic action of the *colostrum* is required for its removal.

The colostric condition, however, of the milk will often remain for some time after parturition, and if so it is likely seriously to affect the health of the offspring. Many fatal cases of diarrhœa in *very young* calves, lambs, and pigs are

due entirely to this cause, and are to be prevented only by attention to the parents, so as to bring their systems into a more healthy state. No cause is more potent in producing a retention of colostrum than *too generous* feeding directly after parturition, on highly nitrogenous and oleaginous substances. We have known whole litters of pigs to be lost from the sows being fed almost exclusively and to excess on barley-meal. The reproduction of colostrum with each delivery shows also the impropriety of "milking round," no time being thus given for this new and important office of the mammæ to be properly performed.

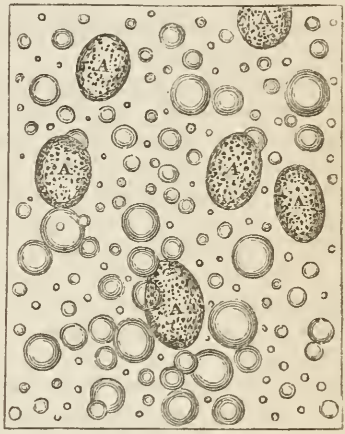

Fig. 8.

Microscopical appearance of *colostrum.* In this fluid, in addition to the ordinary milk globules, granular corpuscles, varying in size from $\frac{1}{2000}$th to $\frac{1}{800}$th of an inch are present. These corpuscles are marked A, A, in the illustration.

3*rdly, Age.*—Although the amount of milk yielded by a heifer, or other young animal, may be considerable, it is not until adultism has been reached that the mammary glands secrete the *fullest* quantity. At this period all the organs are in their most vigorous condition, and if not overtaxed may remain for several years without showing any marked signs of decay. Both the quantity and quality of the milk of old animals have suffered loss, the latter often more so than the former, and as such, cows of this description ought not to be retained for dairy purposes.

4*thly, Temperament.*—This plays an important part in the production of milk. A cow of an irritable or nervous temperament is rarely a good milker. It is the quietly disposed, bland, and mild animal which fills the pail. The influence of the mind over the secretion of milk is very remarkable. This is doubtless best seen in the human subject, but it belongs also to the lower animals. Dr. Carpenter writes that "the formation of this secretion is influenced by the nervous system to a greater degree, perhaps, than that of any other. The process may go on

continuously, to a slight degree, during the whole period of lactation; but it is only in animals that have special reservoirs for the purpose, that any accumulation of the fluid can take place. In the human female these are so minute as to hold but a trifling quantity of milk; and the greater part of the secretion is *actually formed while the child is at the breast.* The irritation of the nipple produced by the act of suction, and the mental emotion connected with it, concur to produce an increased flow of blood into the gland, which is known to nurses as the *draught;* and thus the secretion is for the time greatly augmented. The draught may be produced simply by the emotional state of mind, as by the thought of the child when absent, and the irritation of the nipple may alone occasion it; but the two influences usually act simultaneously.

"It is not only in this way that the mammary secretion is influenced by the condition of the mind, for it is peculiarly liable to be affected as to quality, by the habitual state of the feelings or even by their temporary excitement. Thus a fretful temper not only lessens the quantity of milk, but makes it thin and serous, and gives it an irritating quality, and the same effect will be produced by a fit of anger."

It is well known that cows, which have been used to suckle their calves will, for a time, on their removal, diminish greatly in the quantity of milk. Some never regain it; that is, the mental impression caused by the mere withdrawal of the secretion by a milker is insufficient, in the absence of the young one, to excite the vascular through the nervous system to a full secretion. Many cows also are known to withhold their milk from a new milker. One explanation of this is that after the reservoirs are emptied, over which the animal has no power, the gland does not continue to secrete its accustomed quantity, the mind of the animal not being reconciled to the altered circumstances in which she is placed. It has likewise been stated that in some parts of India, retailers of "milk from the cow" perambulate the streets driving the animal and carrying a stuffed calf, which they place in the front of the cow each time they serve a customer; and that unless this expedient is adopted, the animal, having been long accustomed to it, yields but a very insufficient supply. All this goes to prove the influence of the nervous system over lactation, and how necessary it is that attention should be given to the temperament of our dairy cows.

We may perhaps be permitted to add to these remarks by drawing an illustration from another of our domesticated animals. In many high-bred bitches, and spaniels in particular, it frequently happens that an animal having been at heat, but not allowed access to the male, at the end of the period which would other-

wise have been the one of *utero-gestation*, her mammæ are filled with milk; the animal is much excited, and comports herself precisely the same as if she had been delivered of a litter of puppies. This fact beautifully exemplifies the sympathy which exists between all the organs of generation, and which is alone maintained, kept in full vigour, and brought into operation by the nervous system.

5thly, Health.—A freedom from disease, either of an acute or chronic character, is of the first importance to the production of milk. A cow affected with *acute* disease is sure to diminish in the quantity, and probably will cease entirely in her yield of milk, while such disease lasts; and even on her recovery will not give anything like the amount she had previously done. It is, however, affections of a chronic nature which exert the most serious consequences. Without threatening any immediate danger to life they frequently, by their persistency, destroy the value of the animal for milking purposes. Chronic diseases of the liver especially are among this number. Maladies affecting the gland itself will evidently exert a deleterious influence, by their direct action upon its secretive power; but otherwise they are of no more serious import than diseases of the internal organs.

Not only do organic affections thus interfere with lactation, but simple functional derangement of any of the viscera does the same thing. Evidence of this is afforded in ordinary cases of diarrhœa, which depend merely on some irritating or deleterious aliment having entered the intestinal canal. As it is unnecessary, however, that we should go into detail with regard to the several acute or chronic diseases of milking cows, or of the different causes leading to functional derangement of the various organs of the body, we pass on to speak of—

6thly, Temperature.—The injurious effect of the extreme heat of summer or of the cold of winter over the animal functions requires but little exemplification. Cows exposed to either suffer in their lactation. A highly elevated temperature, by keeping an animal in a state of excitement, often produces functional disorders of the liver which lead to diarrhœa, and a consequent diminution in the secretion of milk; while the opposite state of the atmosphere, by depressing the vital functions, has a similar result. Notwithstanding this an animal has the power of maintaining a uniform heat of its body under any circumstances it may be placed in with regard to temperature. This heat, which is equal to about 100° of Fahrenheit, is, however, kept up with less tax on the system under some circumstances than under others. As a general principle a greater demand is made on some of the elements of the body in *cold* than in warm weather.

It is principally by the union of the oxygen of the atmosphere

with the carbon and hydrogen of the system, and the consequent production of carbonic acid gas and watery vapour, which takes place in the capillary vessels of the entire organism, that animal heat is produced. The carbon and hydrogen are thus being constantly consumed, and to supply their place the hydro-carbonaceous materials of the body are appropriated. By the process of respiration oxygen enters the system; and by the same process the carbonic acid and watery vapour are cast out. Cream, as we have elsewhere stated, consists chiefly of the oleaginous or hydro-carbonaceous elements of the milk, their source being the food; but if these are consumed while still in part within the blood to keep up the heat of the body, it follows as a consequence that a diminished amount will be found in the milk. Protection from the cold and inclement weather of winter thus becomes indirectly the cause of supply of a given quantity of food, and the same protection is no less beneficial in allaying undue excitation during the heat of summer.

7thly, Exertion.—To a considerable extent exertion proves detrimental to the condition of a milking animal, in the same manner as does exposure to a low temperature; while the two combined are sure to be attended with serious consequences. By the increase of respiration which takes place consequent on exertion the hydro-carbonaceous substances are more rapidly consumed, and a diminution of cream is the result. Cows pastured on the outlying parts of the farm will rarely yield the same amount of butter which they would do if kept near at home, all other things being equal.

It has been stated on very good authority that cows pastured in mountainous districts, as in Switzerland, where they are obliged to use a great deal of muscular exertion, and are much exposed to atmospherical influences, are excellent as cheese-making animals, but that their milk is deficient of cream. The explanation of this is to be found in the physiological fact we have previously spoken of, namely, the consumption of the hydro-carbonaceous elements of the system. It appears, however, that there is not merely a diminution of these matters but a positive increase in the amount of caseine, which seems to prove that this is derived from the disintegration of the azotised tissues of the body. We might here close our account of the principal causes which modify the secretion of milk, both in quantity and quality, but it is necessary that we briefly allude in the last place to—

Food.—Of itself there is no one cause so potent for good or evil as the supplying of milking cows with proper or improper food. To obtain all the benefits which we desire, care should be taken that the aliment should be rich, as has been previously stated, in all the elements of blood. Good blood makes good

milk. It was at one time supposed that by a liberal supply of mere fatty matters a proportionate quantity of good butter would be obtained from the cream. Experience has shown that which physiology would intimate to be correct, namely, that nitrogenised matters are equally as important as oleaginous or saccharine in the production of rich milk, and that such milk gives the fullest amount of good cream. If by a well-selected diet the wants of every part of the organism are supplied, it follows that by a generous, as well as a proper one, an unconsumed amount of nutritive matter exists in the blood, which can be elaborated by the functions of the mammary glands into milk. Elsewhere we have stated, and we close our remarks by repeating, that *milk is but blood in another form.*

IV.—*On the Transformation of Ægilops into Wheat.* By Professor HENFREY.

IN the 15th volume of this Journal (page 167) was published a translation of a paper written by M. Fabre, of Agde, in the South of France, the object of which was to show that cultivated wheat, the origin of which is altogether obscure, had been produced from the grass called *Ægilops ovata* through the influence of cultivation. The facts there brought forward naturally attracted much attention, but the opinions founded on them have been very different. In this country there is seemingly a tendency to admit M. Fabre's explanations as valid; but they appear by no means conclusive when compared with the results of the experiments of Dr. Godron, contained in the following pages, and which have been confirmed by several other botanists.

The suggestion that the *Ægilops triticoides*, which formed the first stage of transition from *Ægilops ovata* towards wheat, is a hybrid production, appears to have been earliest made by M. Regel, now Director of the Botanical Garden at Moscow, but M. Godron was the first to give practical, and, as it would appear, decisive proof in favour of this view. Professor Planchon of Montpellier has repeated the hybridizing experiments with success, as have also MM. Groenland and Vilmorin, near Paris. Professor Henslow has also found a *triticoid* form of *Ægilops squarrosa*, which proved barren; affording rather a presumption that it was a hybrid. Mr. Brown, of Colchester, has given an account of a similar form, which was fertile and was cultivated for four years, without however becoming *Wheat*. We subjoin reference to the notices on this subject, chiefly expressions of opinion, which have been published in this country since we printed M. Fabre's paper in 1854:—*Gardener's Chronicle*,

1855, p. 151; 1855, pp. 582, 587; 1857, pp. 617, 627, 796. (Notices by Messrs. Lindley, Bentham, J. D. Hooker, Henslow, Seeman, &c.)

The two papers here translated were published in the French '*Annales des Sciences Naturelles*,' in the 2nd and 5th volumes of the Fourth Series of that Journal, 1854 and 1856; M. Planchon's observations appeared in the '*Annales de la Société Linnéenne de Lyon*,' *nouvelle série*, iv.; those of MM. Groenland and Vilmorin in the '*Bulletin de la Société Botanique de France*,' iv. p. 573 (1856), and in the Berlin '*Jahrbucher fur wissenschaftliche Botanik*,' i. p. 514 (1858).

It is necessary to notice that the French botanists now distinguish the plant finally resulting from M. Fabre's experiments, under the name of *Ægilops speltæformis*, from the form which occurs wild and is a simple hybrid, the *Ægilops triticoides*, of Requien.

On the Natural and Artificial Fertilization of Ægilops by Triticum. By Dr. Godron.

Notwithstanding that the attention of naturalists was awakened, more than a century ago, to the consideration of hybridity in the vegetable kingdom, the investigation of hybrid plants developed spontaneously was for a long time neglected. Yet this study is not only very interesting in itself, but, in addition, possesses undeniable scientific importance.

On the one hand *crossing* often renders certain species of plants very "critical," and the determination of these becomes almost impossible if we do not carefully distinguish the forms arising through hybridation from those which constitute genuine specific types. By this means Messrs. A. Braun, Koch, Wimmer, Fries, Nägeli, Lang, &c., have succeeded in elucidating certain genera of plants previously almost inextricable, and which were the despair of descriptive botanists. Of this we have examples in the genera *Cirsium* and *Carduus* (thistles), *Mentha* (mints), *Verbascum* (mulleins), *Polygonum* (docks), and *Salix* (willows).

On the other hand, hybrids, when fertile, tend to return after a certain number of generations to one of the two types which have given them birth; and as the crossings may take place in opposite directions, we sometimes meet with complete series of intermediate forms between two perfectly distinct species. Thus, M. Grenier has gathered, in a meadow in the environs of Pontarlier, such a series of forms between *Narcissus pseudo-narcissus* and *N. poeticus*; and M. le Jolis has likewise observed a complete set of individuals presenting all the modifications which can exist between *Ulex nanus* and *U. europæus*, compre-

hending in the midst of them *U. Gallii*. Other exactly similar instances might be cited.

An observer, having before him one of these series which appear to unite and blend two species incontestably distinct, would be naturally led, if he overlooked the hybrid origin of the intermediate forms, to regard, for example, *Narcissus pseudo-narcissus* as a simple metamorphosis of *Narcissus poeticus*, or, in other words, to admit the transformation of one species into another, whatsoever might be the morphological value of the characters which separated the two types.

The study of hybrids produced spontaneously is therefore useful to descriptive botany, but it has a far greater value in reference to the fixity of species. The observations and experiments which we are about to recount will place in a still stronger light the foregoing reflections.

The origin of cultivated wheat, which has not up to this time been found in a wild state in any part of the globe, already occupied attention among the naturalists of ancient times, and it was even attributed to *Ægilops* by the Greeks. This opinion has been revived in our own times by several botanists, and lately by M. Fabre, of Agde, and Professor Dunal. These skilful observers have done what their predecessors neglected to do: produced facts in support of their views, and it is necessary here to recall the results of their observations.*

It is well known that the spike of *Ægilops ovata* breaks at its base when mature, that it does not become separated into pieces, and that it preserves its seeds tightly fixed to the floral envelopes. This spike is introduced into the soil all in one piece, and the four seeds it contains give birth in the following year to four plants of *Ægilops*, distinct from one another, but with their roots interlaced, and forming by their union a little tuft. Ordinarily all these seeds reproduce the parent plant; but sometimes one of the seeds gives birth to a plant very distinct from the first, and having an aspect which reminds us of cultivated wheat; this is *Ægilops triticoides*. This very interesting fact, ascertained by Mr. Fabre, I have often verified in the vicinity of Montpellier. M. Fabre took the resolution of sowing the seeds of *Ægilops triticoides*, and followed through twelve successive generations the products furnished by the seeds originally gathered from this wild grass. The plant assumed by slow degrees a taller growth, the spike became larger, it ceased to be brittle at the base, its glumes lost one of the two awns which distinguish *Ægilops triticoides*; in a word, this plant acquired, in part at least, the characters of wheat.

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* See Journal of the Royal Agricultural Society, vol. xv. p. 167

Must we conclude from these facts that cultivated wheat derives its origin from *Ægilops ovata?* This opinion has been expressed in the most formal manner by the learned Dean of the Faculty of Sciences of Montpellier. This conclusion seems to us serious, and we are led to ask if the opinion pronounced by M. Dunal really results from a rigorous induction from the facts observed by Mr. Fabre. To judge this question maturely, it appears above all necessary to take into account not only the principal fact, but also the circumstances in which it was produced; all having possible importance, none must be neglected, especially when we have to pronounce upon a subject of so high a scientific influence. An examination of these circumstances will conduct us to a solution which direct experiment will subsequently prove to confirm.

In the first place, where does *Ægilops triticoides* habitually grow? Our own observations, made in different localities of the South of France, have shown us that the *Ægilops triticoides* is always found on the borders of wheat-fields, or in their neighbourhood, and never in sterile places far removed from the cultivation of cereals. M. Fabre has, indeed, said that he gathered it in an uncultivated spot completely surrounded by vineyards. This is true; but it must be added that extensive wheat-fields exist at a short distance.

We may remark further, that *Ægilops triticoides* is never very abundant anywhere, but occurs scattered here and there as if really the product of accident.

On the other hand, this plant, gathered by M. Fabre at Agde, assumes, from the first year of cultivation, absolute y the habit of the *Touzelle* wheat, generally cultivated in the environs of that town, and this remarkable circumstance has been observed by M. Fabre himself. Hence, one is led to ask if the *Touzelle*, instead of originating from *Ægilops ovata*, transformed into *Ægilops triticoides*, may not, on the contrary, have something to do with the production of the latter plant. But this is not all: where beardless wheat is cultivated, *Ægilops triticoides* itself has the awns almost rudimentary; while, on the contrary, it is bearded where bearded wheat is grown. Thus, *Ægilops triticoides* varies; and since its variations are in relation with those presented by the wheats cultivated in each locality there is a probability that the wheat has some influence in the production of this form of *Ægilops*.

When M. Fabre sowed the seeds of the wild *Ægilops triticoides* the first time, he observed that few of the stems produced seeds, and those only furnished a small quantity. With the view of repeating the series of experiments made by this ingenious observer, we likewise sowed the seeds of the wild *Ægilops*

triticoides in the autumn of 1852. The seeds germinated perfectly; but although the plants flowered they yielded no seeds, yet several other species of *Ægilops* sown in the same place fructified very well.

Another circumstance, which must not be overlooked, is this: the same spike of *Ægilops* gives birth at the same time to plants of *Ægilops ovata* and of *Ægilops triticoides;* that is to say, to two plants, so distinct and so well characterised that, hitherto, no one has hesitated to consider them legitimate species. But this spike does not ever give birth to anything else: it has never produced forms intermediate between the two plants. Hence, we should have here a transformation always sudden, always equally striking. This pretended metamorphosis is never made by degrees, and does not require for its completion the long period of time which the declared partizans of the variability of species suppose to be an indispensable condition. Cultivation, so powerful a modifier, has never been seen to develope in plants changes so important, and, above all, so rapid. Therefore, we cannot admit that there is here a simple transformation of one species into another.

But science is now rich in facts similar to that discovered by M. Fabre: it furnishes us with a very simple explanation of the origin of *Ægilops triticoides*, and of the modifications through which it subsequently passes in approaching and becoming almost confounded with wheat. *Ægilops triticoides* presents all the characters of hybrid plants: sudden production of a plant which is linked by its character at the same time to two distinct species; influence of varieties and races upon the intermediate product; accidental origin here and there among the parents; fecundating action very little developed in the plant, and reversion of the fertile individuals towards the male type after a few generations. Not one of these characters is deficient; and it appears to us evident that *Ægilops triticoides* is nothing else than a hybrid, resulting from the accidental fertilisation of *Ægilops ovata* by *Triticum vulgare.*

Although the facts above indicated seem strictly to justify the conclusion I have deduced from them, I felt it requisite, in the face of a different opinion, pronounced by one who is an authority in science, to have recourse to direct experiment, and in this way to give to that conclusion the character of a complete demonstration. I have attempted, therefore, to reproduce *Ægilops triticoides* by the artificial fertilization of *Ægilops* by *Triticum*, and it merely remains to make known these experiments and the results they have produced.

I have adopted three modes of proceeding. In the first experiment I sought to effect the artificial fertilization without muti-

lation of the flowers of *Ægilops ovata*, submitting this plant simultaneously to the action of its own pollen and that of the foreign pollen. In the second trial the mutilation was only partial; in the third it was complete. The experiments of fertilization were made at Montpellier in the month of May, 1853, and the products obtained were planted in pots at Besançon on the 27th of March, 1854, under protection from the action of late frosts.

First Experiment.—On the 20th of May, 1853, I scattered the pollen of *Triticum vulgare muticum* upon six spikes of *Ægilops ovata* which were about to flower, intending thus to place the *Ægilops* in the same conditions as are present when, growing on the border of a wheat-field, it is accidentally affected by the fecundating dust of that cereal. The foreign pollen penetrates the more readily into the flower from the circumstance that, at this epoch of the life of the plant, and until after the flowering, the glumellæ of *Ægilops ovata* naturally separate to the extent of about the twenty-fifth of an inch. These six spikes were gathered directly they were ripe, and planted in the spring of the next year. They furnished the following result: five of the spikes produced *Ægilops ovata* exclusively; the sixth likewise produced several stems of this grass, but one of the seeds gave birth to two stems much taller than those of the parent plant, and the spikes of these presented the most perfect resemblance to those of that variety of *Ægilops triticoides* in which the awns are half-abortive, and, as it were, rudimentary. This variety, which I have gathered in a wild state about Montpellier, is, therefore, the result of the fertilization of *Ægilops ovata* by the beardless wheat.

Second Experiment.—Not being able to foretell the success of the preceding experiment, and desiring to reproduce the very curious fact of two distinct plants arising from the same spike of *Ægilops ovata*, I had recourse to mutilation and artificial fertilization carried into effect upon two flowers only of each spike of the *Ægilops*.

The removal of the anthers before the natural fertilization can take place, and at a time when these organs are still enclosed in the flower, seems at first sight an operation very delicate to execute. But it is not at all so if the method of operating be followed that I adopted, and which requires no other instruments than the fingers and a small pair of forceps with very fine points. I am induced to describe this mode of operating because it is extremely simple; and a knowledge of it will enable all botanists to repeat and control my experiments. It consists in taking fast hold of the awns of the outer glumella, as near as possible to their origin, between the index finger placed beneath and the

thumb above; then, pressing with the cushion of the middle finger upon the base of the spike in such a way as to impress a slight see-sawing motion, which allows at the same time of fixing the spike firmly between this finger and the index finger. By this movement the external glumella is curved a good deal outwards, the flower is widely opened, and the reproductive organs can be easily distinguished. I must give warning that the outer glumella sometimes carries off the inner glumella in its movement: but as this latter is simply membranous, and projects above the external one, nothing is easier than to separate it. I then proceed to remove the stamens, extracting them one by one by seizing the filaments with a fine pair of forceps. For these organs is immediately substituted an anther of wheat, selected from those beginning to open, and this is placed transversely above the stigmas. The envelopes of the flower are then gently pressed together again. The wheat anther then discharges its pollen; moreover, its presence forms an obstruction to the access of the proper pollen of *Ægilops* to the stigmas of the flowers subjected to mutilation, which ensures the success of the operation.

I proceeded in this way with four spikes of *Ægilops ovata*, and I tried the fertilization upon two flowers of each of them with the pollen of *Triticum vulgare muticum*. I obtained from these four spikes, planted entire and at a distance from one another, a certain number of plants of *Ægilops ovata* and nine specimens of *Ægilops triticoides*, which only differed from those gathered at Agde by M. Fabre by their taller stature (the summer was wet) and their looser and completely green spike. But the variety of wheat which I used for the fertilization is distinguished from *Touzelle* wheat by precisely these last two characters. I operated on the same day, and in the same manner, upon two spikes of *Ægilops triaristata;* and upon two flowers of each of these spikes I replaced the proper anthers by anthers of *Triticum durum barbatum*. One of the spikes reproduced *Ægilops triaristata* exclusively; the other afforded me three specimens of a hybrid remarkable for its long beards, and which, so far as I know, has never been observed before.

Third Experiment.—On the 25th of May, 1853, I completely removed the anthers from four spikes of *Ægilops ovata*, removing the upper spikelet, which contains only male flowers. I placed in each previously perfect flower an anther of *Triticum spelta barbatum* beginning to open. I obtained two stems of a new hybrid, and not a single representative of the parent plant.

From all these facts we may draw the following conclusions:—

1. Hybridity may occur spontaneously among the grasses, and

Ægilops triticoides is the first known example of a hybrid observed in this family.

2. The species of *Ægilops* must be united generically with *Triticum;* which is, besides, confirmed by the shape of their fruit, an organ which, in the family of the grasses, furnishes far more important characters than the conformation of the floral envelopes.

3. The observations of M. Fabre upon *Ægilops triticoides* do not in any way prove that cultivated wheat originates from *Ægilops ovata*, or that one species can be transformed into another.

On Ægilops triticoides and its different Forms.—Second Memoir by Dr. GODRON.

When MM. Fabre and Dunal announced that *Ægilops triticoides* originated from a spike of *Ægilops ovata*, while some seeds of the same spike simultaneously reproduced exactly the latter plant, a fact so unexpected riveted attention, and most of the botanical journals published in Europe, and even in America, discussed the important questions raised by this discovery. The well-known talent for observation of M. Fabre, and the scientific authority of Professor Dunal, made it difficult to suppose that there had been any error of observation, in reference to a fact so easy to verify.

Two eminent botanists, however, neither of whom have ascertained for themselves, in the plains of Languedoc and Provence, the assertions which had been promulgated, received the memoir of MM. Dunal and Fabre in very different ways.

Dr. Lindley, in England, raising no doubt as so the reality of the facts, likewise admits the conclusions which those two observers had drawn from them, sacrificed his old idols and accepted the doctrine of the variability of species.* The publication of my memoir on the Fertilization of *Ægilops* by *Triticum* (see above) did not at all modify his new convictions, and he will persist, he says, until I have made known the origin of wheat. But as Dr. Asa Gray,† has very properly remarked, my object was not to discover the origin of wheat, but that of *Ægilops triticoides*.

M. Jordan, in France, in a memoir published in 1853,‡ simply denied the principal fact observed by MM. Dunal and

* This is not a clear statement of Dr. Lindley's view, as we understand it. He does admit *variation* of species, but not *mutation*. He regards *Ægilops ovata* and *Triticum vulgare* as forms of one species.—A. H.

† Silliman's Journal, 2nd ser., vol. xx. p. 134.

‡ Jordan, 'Sur l'Origine des divers Variétés et Espèces d'Arbres Fruitiers, &c.'

Fabre. I was the more surprised at this from the fact that, having been previously consulted, I had assured him that, after a rather large number of observations made in the environs of Agde and Montpellier, I had remained perfectly convinced that *Ægilops triticoides* originated from *Ægilops ovata.* Was this on my part the result of preconceived ideas, which had blinded me to such an extent that I saw what did not exist? This fact shocked my convictions as to the fixity of wild species as strongly as it had done those of M. Jordan. But I was compelled to acknowledge it as incontestable, and my first care was to study the circumstances under which it is produced. The facts I observed, and which I have indicated with the details in two successive memoirs,* put me on the road to the discovery of the hybrid origin of *Ægilops triticoides.* Therefore my point of departure was not a simple hypothesis; and, even if it had been so, this should not have been turned into a weapon against me, now that this hypothesis is confirmed by direct experiment. Besides, has not hypothesis been the origin of a number of important scientific discoveries? In this question now under discussion only two suppositions are possible; either we must admit, with MM. Dunal and Lindley, the variability of wild species, or acknowledge that the very striking differences which distinguish *Ægilops triticoides* from *Ægilops ovata* are due to hybridity; there is no other possible alternative, and M. Jordan himself, as we hope to demonstrate, must choose between them.

But I return to the fact of the two forms of *Ægilops* springing from the same spike of *Ægilops ovata*, because it is of the first importance for the solution of this question. Not content with having assured myself of it in the plains of the South, I have reproduced it by the artificial fertilization of *Ægilops ovata* by *Triticum vulgare.* My spikes of *Ægilops* partially fertilized by wheat, were planted entire and separately in pots, at Besançon. I did not sow *Ægilops triticoides* at the same time, I had none of it at my disposal; therefore there could not have been any error, any mixture of seeds. I will add that perhaps no case of hybridation has ever been accompanied by so many circumstances calculated to assure its authenticity. The Society of Emulation of Doubs took a warm interest in these experiments, and named a committee composed of naturalists, who traced the vegetation of these *Ægilops*, and made to that learned Society a written report which affirmed in a positive manner the facts contained in my memoir on the fertilization of *Ægilops* by *Triticum.* Specimens of the different products obtained were sent to M.

* 'Quelques notes sur la flore de Montpellier,' p. 11, and the first memoir translated in this article.

Adolphe Brongniart, who had seen them in a young state at Besançon; and this distinguished naturalist, who has investigated so successfully the fertilization of plants, was good enough to make a verbal report, on the occasion of presenting them to the Institute, in which he stated that he considered the hybrid nature of *Ægilops triticoides* proved.

Now, from the examination of these products it follows, with the greatest evidence: 1, that from the same spike of *Ægilops ovata* have originated plants of this plant and plants of *Ægilops triticoides*; 2, that the spikes of *Ægilops ovata* fertilized by *Triticum vulgare barbatum* have given birth to *Ægilops triticoides* furnished with long beards, such as Requien observed; and 3, that from *Ægilops ovata* fertilized by beardless wheat, originated an *Ægilops triticoides* possessing very short awns. This last form, perfectly distinct from the preceding, of which M. Jordan does not speak, is wild, and even tolerably common at Montpellier; it is conformable to the specimens which I obtained by artificial fertilization.

These facts—to my eyes so precise and conclusive that if they be not admitted we must also deny the experimens of Koelreuter, of Gaertner, &c.—excite doubt and even incredulity in the mind of M. Jordan.* It would have been easy, however, for this industrious naturalist to verify them, by repeating my trials of artificial fertilization; he would then have pronounced judgment with full knowledge of the case.

According to him, *Ægilops triticoides,* whether regarded as a hybrid—and he still doubts if it be really one—or of some different origin, is but a simple malformation of *Ægilops ovata.*

Let us examine first the second supposition; we will return to the other afterwards.

If *Ægilops triticoides* is a malformation of *Ægilops ovata*, without intervention of foreign pollen, this is a serious fact for the doctrines of M. Jordan and for those of all the botanists who, like him, suppose the immutability of species, not only wild but even of cultivated species. Look at the differences which separate *Ægilops triticoides* from *Ægilops ovata.* Without dwelling on the characters derived from the organs of vegetation, the spike has a very different general form in the two plants; so different that this character alone suffices to distinguish them at the first glance, and that probably no person has ever confounded them. The plant of Requien, moreover, possesses much more numerous spikelets. The valves of the glume of *Ægilops ovata* are regularly rounded on the back, and the principal nerves, which

* 'Mémoire sur l'Ægilops triticoides.' Ann. des Sc. Nat., 4 ser. Botanique, t. iv. p. 298.

terminate at the middle of the base of each of the awns, are almost equal to each other; so that each valve may be divided longitudinally into two halves nearly symmetrical. In *Ægilops triticoides*, on the contrary, not only are the valves of the glume larger, but one of the lateral nerves—the last but one—acquires greater development than the others, and forms then a keel, strongly marked above, dividing the valve into two unsymmetrical parts. This keel is certainly less projecting than in the true species of *Triticum*, but it is very clearly visible; and it is not observed in *Ægilops ovata*. The awns of the glume are three or four in number on each valve of *Ægilops ovata*, and moreover they spread outwards; habitually only two exist in *Ægilops triticoides*, and these are constantly erect. It is true that between the two awns of this latter plant we ordinarily see a tooth which represents an abortive awn, but this is not constant; and sometimes this tooth is wanting altogether in the lower spikelets of *Ægilops triticoides*, which separates it still farther from *Ægilops ovata:* we shall recur to this fact. Now these distinctive characters are much more decided than those which separate *Ægilops triticoides* from *Ægilops speltæformis*. This is so evident that M. Jordan himself, in his memoir on the Origin of Varieties and Species of Fruit-trees, considers *Ægilops triticoides* as a species quite distinct from *Ægilops ovata;* and he confounds *Ægilops triticoides* with *Ægilops speltæformis*, as is proved by the following passage, which I quote from that work:—"Thus, therefore, the plant of which M. Fabre sowed the seeds is exactly *Ægilops triticoides* of Requien: he is right in this point; but that which he obtained from their seeds, and cultivated for twelve years, is still exactly the same *Ægilops*, and he is deceived when he believes that he sees something different, or even a notable change of characters. We have attentively compared cultivated and wild specimens of his plant, ... and it has presented only unimportant differences, insufficient even to constitute a variety, and analogous to those presented by every plant, when we compared specimens grown in a good soil with those which have been taken from a sterile field. M. Fabre is equally deceived when he believes that his wild *Ægilops triticoides* has been derived from *Ægilops ovata;* there is no reason why we should suppose that *Ægilops ovata* has produced *Ægilops triticoides* rather than the latter has produced *ovata*. Both hypotheses are absurd, doubtless, but one is not less defensible than the other." M. Jordan expressed himself thus in 1853. The plant cultivated by M. Fabre, which three years ago M. Jordan did not regard even as a simple variety, is now a legitimate species; it is *Ægilops speltæformis*. This form had been well distinguished by M. Fabre at the time when M. Jordan completely ignored it; but if

this plant is now in the eyes of the latter a real species, how can he regard *Ægilops triticoides*, much better characterised, as a simple malformation of *Ægilops ovata*—an opinion which M. Jordan himself, in 1853, held to be "an enormous absurdity"? We have to do here with plants of the same genus, in which the characters drawn from the glume and its awns ought to have equal value as specific characters; but if M. Jordan refused to admit that differences so decided and so easy to appreciate, which separate the two species of *Ægilops*, are insufficient to distinguish them, what is to be said of some of the other species which M. Jordan has established in characters appreciable by him, but which escape all other observers?* Now since M. Jordan at present considers as scarcely a variety the *Ægilops triticoides*, which was recognized before M. Fabre's discovery as a well-characterized specific type, by botanists most scrupulous in respect to the vegetable species, it follows necessarily that the indefatigable botanist of Lyons (M. Jordan), not only completely invalidates a great number of species which he has published, but, beyond this, he recognizes implicitly the variability of species, even wild ones.

But admitting for a moment that *Ægilops triticoides* is merely an accidental malformation of *Ægilops ovata*, how will M. Jordan explain the fact, which he affirms in a positive manner, that *Ægilops triticoides* sometimes grows in places where *Ægilops ovata* is not met with? This last plant would, in such case, be deformed even in localities where it does not exist. It is his business to reconcile with his new opinions this fact, which he was the first to make known, and which, so far as we know, has not been re-observed by anyone else.

Is this supposed transformation of *Ægilops ovata* into *Ægilops triticoides* the result of the sterility of the latter plant?

In the first place, is *Ægilops triticoides* always sterile? In supposing this absolute sterility, M. Jordan takes his stand upon negative facts sufficiently vague. But it would be important to know if the attempts made in the gardens of Avignon and Montpellier to reproduce the seeds have been frequently renewed, and at what epoch of the year the sowings took place; for, as is well known, the *Ægilops* of the South of France begins to germinate in autumn. M. Jordan relies upon the testimony of M. Touchy, which I do not question: indeed I rely upon it also myself. In 1852, I received from M. Touchy two specimens of *Ægilops triticoides*, and I find on the label the following indication:—"Appeared in a field of millet, in 1848, and has been propa-

* In thus expressing ourselves we have no intention of proscribing in mass all the new species published by M. Jordan. We admit that he has created some very safe ones; but of others we are not convinced of their legitimacy.

gated in the same field up to the present time,"—that is to say, for four years. Now these two specimens each have the valves of the glume furnished with two short awns and an intermediate tooth ; this is the form *submutica* of *Ægilops triticoides*, of which we have spoken above.

In the autumn of 1852, I myself sowed in my garden, separated from cultivated corn by the whole length of a suburb of Montpellier, seeds of the same form of *Ægilops triticoides*, gathered by me in the environs of that town. They germinated perfectly; the plants flowered, but yielded no seed. Yet this plant had evidently been reproduced at least in one generation.

It is shown, besides, in M. Fabre's experiments, that during the earlier years of the sowings he obtained but a small number of seeds, and that a certain number of plants, although belonging to the second and the third generation, yielded none. This refers to *Ægilops triticoides*, not yet to *Ægilops speltæformis*, for M. Fabre carefully noted that the majority of the plants of the first two years of cultivation presented two awns on each valve of the glume; among them some were fertile, and the sowings were thus capable of being continued for a long series of years.

If it is accurate to say that the wild plants of *Ægilops triticoides* rarely produce seeds, which is easily to be ascertained in herbaria, the preceding facts, nevertheless, prove that this plant does sometimes possess them, and that it is able to propagate for a considerable number of generations. There is nothing in this contrary to the doctrines usually held respecting hybridity ; on the contrary, these facts confirm them, and this was even one of the circumstances which made me suspect the hybrid nature of *Ægilops triticoides.*

But admitting, even hypothetically, that absolute sterility, would it thence follow that *Ægilops ovata* became transformed into *Ægilops triticoides?* This is pure supposition, in favour of which there does not exist any known fact or even any analogy. Does the sugar-cane, which, after reproduction by buds for a long series of years, has lost the faculty of producing seeds, present flowers and a panicle different from those of the wild sugar-cane? The *Phragmites* and many other grasses which propagate vigorously by stolons, are very often sterile, but do not, on that account, exhibit appreciable transformations in their floral organs. Why should it be otherwise in *Ægilops ovata?*

But this is not all: how shall we explain, if we adopt M. Jordan's supposition, that *Ægilops ovata*, when its flowers have been smeared with a foreign pollen, or its own stamens have been removed and replaced by those of wheat, produces, in the following generation, not only plants of *Ægilops triticoides*, but two modifications of that plant, according as the foreign pollen applied

in the preceding year belonged to a bearded or a beardless wheat? This result has been demonstrated by my experiments.

It still remains to notice, that M. Jordan, who has so strongly opposed the opinion promulgated by MM. Dunal and Fabre—that wheat is only a transformation of *Ægilops ovata*,—if he admits, definitively, the supposition which we combat, would accept by this very admission the idea that this transformation of *Ægilops ovata* into wheat went through, really, one-half of the course which has been assigned to it by those skilful observers.

The constant sterility of *Ægilops triticoides*, if really demonstrated, would not explain the origin of the differences which separate this plant from *Ægilops ovata.*

Let us now examine the second supposition of M. Jordan. If it be admitted that the transformation of *Ægilops ovata* into *Ægilops triticoides* is the result of hybridation, which we believe we have demonstrated, is it true that this latter plant is yet merely, as he thinks, a modification of *Ægilops ovata*, presenting nothing of the paternal type? The stature of the hybrid *Ægilops*, which rises far above that attained by *Ægilops ovata;* its erect direction; its far more robust aspect, even in the wild state; the breadth of its leaves; the general form of its spike, which reminds us of that of wheat, and which has earned for this plant the name of *triticoides*, which M. Jordan justly regards as "very happily chosen;" the direction of the awns; and, above all, that keel which descends from the principal awn at some distance from the internal border of the glume,—are not these characters which belong to wheat, and by no means to *Ægilops ovata?* It follows from this, that if *Ægilops triticoides* preserve some of the characters of the maternal type, which I am far from denying, but affirm, yet it also presents very prominent marks of its paternal origin.

But the argument upon which M. Jordan especially insists, is, that in spite of the modifications undergone by *Ægilops ovata* by hybridation, the hybrid product which results from its fertilization by wheat would not cease to belong to the genus *Ægilops.*

The genus *Ægilops* is a purely artificial genus, preserved by tradition, out of respect to our predecessors, but which does not rest upon a single character really generic, and which, in my opinion at least, may not be separated from the three species of *Triticum.* M. Jordan distinguishes the two groups by the following characters: 1. in *Ægilops*, the spike at maturity becomes detached from the stalk or breaks up into pieces; the spikelets are not contracted at the base, which at least equals the breadth of the rachis; the valves of the glume are rounded on the back and possess numerous nerves; they bear several awns or teeth

which represent abortive awns. 2. In *Triticum* the spike is not brittle, and is not detached when ripe; the spikelets are contracted at their base, which is not so broad as the rachis; the valves of the glumes are keeled, the nerves are few, and the awn single.

To this definition of the genera I will oppose the following facts: *Ægilops speltæformis*, that at least which M. Fabre obtained after twelve years' cultivation, has a spike not brittle at the base,* and I am certain of this fact, as I shall explain further on. The spikelets are not contracted inferiorly in *Triticum villosum*, P. Beauv., *T. hordeaceum*, Coss., and *T. bicorne*, Forsk., and this base equals or exceeds the rachis in breadth. *Ægilops triticoides* and *speltæformis* have a keel upon the valves of the glume, less prominent than in *Triticum*, but occupying the same position. The nerves are numerous upon the glume of *Triticum spelta*, L. There exists only a single tooth representing the awn to the valves of the glume of *Ægilops speltoides*, Tausch. (which must not be confounded with *Ægilops speltæformis*, Jordan); and except for this tooth the summit of these valves is truncate and rounded at the sides. *Triticum monococcum*, L., has the same organs, terminated by two very strongly-marked teeth, in which the nerves terminate, as is the case in *Ægilops caudata*, L., *cylindrica*, Host., and *ventricosa*, Tausch. Finally, the presence of a tooth representing a second awn is not rare in *Triticum spelta*, L., and is also sometimes seen in *Triticum vulgare*, Vill., *durum*, Desf., and *amyleum*, Seringe.

So that these distinctive characters have nothing precise about them, and with regard to some species, it has been thought necessary to transport them successively from the genus *Triticum* into the genus *Ægilops*, or *vice versâ*, the generic question not having been hitherto definitively settled in reference to these species; I may cite as examples *Triticum bicorne*, Forsk., *Ægilops macrura* and *Ægilops loliacea*, Jaub. and Spach, &c. It is questionable, moreover, whether characters drawn from an organ so unimportant as the glume of the Gramineæ, which represent simple bracts, are of a nature to form the sole basis of natural genera. The fruits, on the contrary, which, since the time of Tournefort, have been considered as furnishing generic characters of high value, have been generally too much neglected in the establishment of genera in this very natural family. Now *Ægilops* and *Triticum* have similar fruits, and these important organs distinguish them very well from *Agropyrum*, *Lolium*, &c., I will add, that the fact of hybridation between *Ægilops* and *Triticum* goes to confirm the union of these two genera into one.

* See M. Fabre's paper in the Journal of the Royal Agricultural Society, vol. xv. p. 175.

If *Ægilops triticoides* has preserved some of the characters of *Ægilops ovata*, which should be the case, it is not therefore a necessary conclusion that these have the importance of characters truly generic, and that our hybrid has preserved none of the characters of *Triticum;* it is, in our eyes, perfectly intermediate between the two species which have given birth to it.

Hence I think myself authorized in maintaining the three conclusions which I have deduced in my memoir on the fertilization of *Ægilops* by *Triticum;* they express clearly what I desired to demonstrate in this essay.

I now arrive at *Ægilops speltæformis*, which in my opinion is only an accessory, an accident, in the question forming the object of my anterior investigations of *Ægilops triticoides.* Whatever opinion may be accepted as to the new species created by M. Jordan, this opinion cannot in any way weaken the proofs of the hybrid origin of *Ægilops triticoides*, a question which seems to me now settled.

According to M. Jordan, I have confounded *Ægilops speltæformis* with *Ægilops triticoides*, and also with *Triticum vulgaris*, whence, in virtue of the axiom that things which are equal to the same thing are equal to one another, he concludes that I have also confounded *Ægilops triticoides* with wheat. This is trying to prove too much. I regret to say it, but both these assertions are quite inexact.

In the first place: is the question about *Ægilops speltæformis*, cultivated for twelve years by M. Fabre, specimens of which I have communicated to M. Jordan? What I have said in my last memoir on this subject is, "The plant has gradually acquired a more elevated stature; *its glumes have lost one of the two awns which distinguish Ægilops triticoides;* in a word, this plant has acquired, *in part at least*, the characters of wheat." This passage has doubtless escaped M. Jordan; at this time I having nothing to add, and nothing to subtract from it.

Is the question relative to the wild *Ægilops speltæformis?* Here confusion was impossible either with wheat or with *Ægilops triticoides.* I have never seen *Ægilops speltæformis* in a wild state, although I have investigated most carefully the species of *Ægilops* which grow in the environs of Agde and Montpellier.

On his side, M. Jordan nowhere says that he himself has seen wild specimens of this plant; he only remarks that M. Fabre speaks of having found it wild in the neighbourhood of Agde, confounding it in this state with *Ægilops triticoides.* I will take the liberty to observe that M. Fabre merely affirms that he has gathered *Ægilops triticoides*, that it has been reproduced with two awns to each valve of the glume, in most of the specimens during the first two years of cultivation, and that in the succeed-

ing generations it preserved only one of these awns. In the absence of well-established facts showing that M. Fabre has made a mistake, and that he has confounded two forms (which nevertheless he has taken so much pains to distinguish), facts which M. Jordan does not bring forward, there is not at present any motive for rejecting as erroneous the observations made by so exact and intelligent a person. In addition to this, the locality of Agde, this locality surrounded by a belt of vineyards, where this skilful observer first gathered his seeds—would be the only one, according to M. Jordan, where *Ægilops speltæformis* has been met with. Now in this very locality, which I have visited under the guidance of M. Fabre, I have seen and collected only the typical form of the *Ægilops triticoides* of Requien; I have still before me the specimens which I brought from there, and which M. Jordan has himself seen in my herbarium. Therefore there is no proof that *Ægilops speltæformis* has been found wild in the South of France, and still less in the East. Yet it would have been rational to have previously established this important fact before throwing doubt upon the modifications which M. Fabre assured us he had obtained by the cultivation of *Ægilops triticoides.* But M. Jordan starts from metaphysical principles which he has created as to species, and which he has expounded at length in the first twelve pages of his work upon the Origin of Fruit-trees. Now if he meets with facts opposing these same principles he systematically denies them, as he has himself taken care to warn us, with much frankness, in the following passage, which is too interesting not to be quoted: "It must be observed," says M. Jordan, "that as the laws of being cannot be contrary to the laws of thought, and as experience can never give results having *absolute* validity, since it is limited in its field of study—if it happen that certain facts appear contrary to the necessary and evident conceptions of the reason, *they must always be rejected.*"* It seems to us it would be equally justifiable, when the facts disagree with M. Jordan's principles, to conclude that his metaphysics do not rest on a very solid foundation. They do not guide even him safely, since at this time he entertains, as we have shown above, and as indeed he avows, an opinion concerning *Ægilops triticoides*, which three years ago he contested and then pronounced judgment on with the greatest severity. We shall not follow him on to this ground; material facts alone are in question here. I will first observe that the three hybrid forms of *Ægilops* which originate spontaneously in the South of France, whether from *Ægilops ovata* or *Ægilops triaristata*, and two

* Jordan, 'De l'Origine des divers Variétés ou Espèces des Arbres Fruitiers,' p. 12.

other forms obtained in my experiments of artificial fertilization—that is to say, five hybrid forms—present, in spite of the differences which separate them, such analogy, that they constitute a little group extremely natural, or if it be preferred, a section of the genus, intermediate between *Ægilops* and *Triticum*. Now by its aspect, the form of its spike, the keel of the valves of the glume, and by its nerves, *Ægilops speltæformis* is referable exactly to this section, and I know of no *Ægilops* recognised as a legitimate species which can be arranged there in this way. Does this leave any probability that this plant originated differently from the other five?

What I have said of the successive modifications undergone by *Ægilops triticoides*, in the hands of M. Fabre, through long cultivation, I borrowed from his memoir. The facts are, in addition, supported by the authority of Professor Dunal, who possesses numerous specimens derived from the different years of M. Fabre's cultivation. I will add that the specimens of the later years, although ripe and tied in little bundles, do not break below the spike; I have been able to verify this fact myself. Now it is quite different with the *Ægilops speltæformis* which I cultivated last year, which I have in cultivation again this year, and the seeds of which I owe to the kindness of M. Decaisne. Here the spikes separate readily from the stalks when mature; therefore this is the form described by M. Jordan. From this it follows that we must suppose that the plant of the earlier cultivation of M. Fabre has become modified, or that there exist two forms of *Ægilops speltæformis;* for this character, derived from the fragility of the spikes, acknowledged as excellent for distinguishing *Agropyrum junceum* from its congeners, and which M. Jordan regards even as a generic character in *Ægilops*, should have in his eyes sufficient value for the establishment of a new species. I will observe in addition, that the nerves of the valves of the glume are diminished in number, and that several of them have been singularly weakened in the plant cultivated for twelve years by M. Fabre, while these nerves have remained numerous and pretty conspicuous in the specimens with a brittle spike, which are probably nearer to the wild state. Nevertheless these are very real modifications, although M. Jordan does not admit them as possible.

I will further remark, in support of the modifications undergone by *Ægilops triticoides* through cultivation, that this plant is not absolutely constant in the wild state, and this new fact goes to confirm, what all experimenters have observed, that hybrids are far from having the same fixity in their characters as legitimate species. In several specimens of wild *Ægilops triticoides* in my herbarium, I see, sometimes in the lower spikelet only,

sometimes in several, that the valves of the glume have two awns, between which the intermediate tooth is altogether wanting; it re-appears in the intermediate spikelets of the same spikes, and in the upper ones it is developed into a third awn, sometimes of great length. I also find, in some of my specimens of the same *Ægilops* obtained by artificial fertilization, the same absence of the intermediate tooth in the lower spikelet, and in one of these specimens all the spikelets but one present this peculiarity, and, moreover, one of the two awns is reduced almost to nothing. Now this exceptional lower spikelet scarcely differs from those of *Ægilops speltæformis*, in which the second awn sometimes re-appears, as even M. Jordan acknowledges. What is there surprising then in the fact of this peculiarity becoming permanent, or almost so, in *Ægilops speltæformis*, when we know that, in this species of *Ægilops*, it is especially the lower spikelets which are fertile? What becomes then of this specific character, resting on a tooth or an awn more or less, to distinguish specifically (and not as forming a passage) *Ægilops speltæformis* from *Ægilops triticoides*, especially since it has been demonstrated that the latter plant is sometimes fertile.

To sum up, it appears to me that the hybrid origin of *Ægilops triticoides* is incontestable; that *Ægilops speltæformis* is proved by the observations made by M. Fabre, and the new facts indicated in this essay, to be only a form, distinct doubtless, but originating from *Ægilops triticoides* modified by cultivation. The question, therefore, rests where I left it in my former memoir, and that is easily explained. Does M. Jordan, on taking up the question of *Ægilops triticoides* a second time and after three years' silence, add any new element calculated to modify it? Has he followed the only truly scientific method, that of observation and experiment, to destroy or weaken the value of the facts produced in the discussion? By no means. His memoir on *Ægilops triticoides* and that on the Origin of Fruit-trees, are reducible, in reference to the present question, to metaphysical considerations, to pure and simple negation of facts observed by other botanists, and to doubts thrown upon their experiments.

One of the editors of the *Annales des Sciences Naturelles*, apparently M. Decaisne, adds the following note:—"I quite agree with M. Godron in reference to the fragility of the spike in the supposed *Ægilops speltæformis*, seeds of which I received from M. Fabre himself, in 1852, under the name of *Ægilops triticoides.* The spike is so caducous when ripe, that the slightest touch makes it fall; it finally falls spontaneously, simply through

becoming dried. I may add that plants of this form which I have caused to be cultivated here (Jardin des Plantes, Paris), since 1852, among other cereals, have always been respected by the birds, which devoured the latter.

"The fact of the successive modification of *Ægilops triticoides*, which after a certain number of years' cultivation tends more and more to approach wheat, far from being improbable, seems to me on the contrary, to agree with the opinion of various experimenters, who think that the descendants of fertile hybrids incline gradually towards the type of one of the two parents, through the gradual elimination of the characters of the other. M. Naudin has recently made known a remarkable example of it in the posterity of a hybrid *Primula*, which, in the second generation separated into two series, one returning to the paternal, the other to the maternal type." *

V.—*Farm Accounts.* By John Coleman, Professor of Agriculture, Royal Agricultural College, Cirencester.

The necessity for keeping some kind of accounts is so generally admitted by farmers that it is unnecessary to dwell upon the importance of the subject. But in order to place the matter in as clear a light as possible, it may be well to make one remark as to the real meaning and purpose of farm accounts. Too many are contented with keeping a mere Dr. and Cr. cash account, which only shows the money received and spent, and gives no trustworthy information as to the state of the profits or loss upon a farm. That this is really the case will be seen at once, when we consider that the condition of the soil and stock form the farmer's real capital, and the balance at the bank may be flourishing, whilst the stock, &c., are yearly depreciating. The balance of the cash account furnishes a criterion as to the healthy state of business, only when we view it in connexion with the state of the capital account at the commencement and end of each year.

It will be the object of this article not so much to lay down a perfect system of bookkeeping, as to point out how the general principles of commercial accounts may be reduced to a form adapted to the general purposes of the farmer. If we look to the mercantile world we find that, though the principles which regulate accounts are the same, the variations in practice are innumerable; so much so that almost every great firm has a system peculiar to itself, adapted to the nature of its business.

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* Comptes Rendus de l'Académie des Sciences,' April, 1856, p. 625.

To a certain extent this will be the case also with farmers' accounts. In pointing out the peculiarities of the plan I recommend, I would wish it to be understood that under varying circumstances the details are capable of alteration and improvements which experience will readily point out.

Considering the great importance of the subject, we should expect to find much useful information already made public, and systems laid down, which, after mature consideration and lengthened experience, have been proved the most practicable; and yet, with the solitary exception of the system advocated by Mr. Morton in the 'Cyclopædia of Agriculture,' which is in many points extremely good, I cannot refer the reader to any plan that can be recommended. Much has certainly been written about farm accounts from time to time, but to very little purpose, the plans proposed being either too diffuse for men actively engaged all day in the fields, or too intricate for ordinary minds to comprehend; or, on the other hand, they are too primitive to be of much service, failing to afford any explicit statement of the profit and loss upon the whole year's transactions.

Accounts of the first kind have usually emanated not from well-informed practical men who understood the difficulties they had to encounter, but from accountants or men of mercantile talents, who, being familiar with their own kind of accounts, fancied that the farmer had only to alter the items to make them equally applicable to himself. Nothing is more absurd, as there is no parallel between the two cases. Farmers require simple accounts, calculated to prove all that can be proved, and yet so easy to keep, requiring such a short time daily to work up, that it will be a pleasure rather than a toil to attend to them. With these few preliminary remarks we proceed to explain the system of accounts acted upon and taught at the Royal Agricultural College.

A farmer's accounts should be made up once a year. Any period of the year may be chosen, though it is best to choose the time when there is least corn in the rickyard, and least live-stock in the yards. Lady-Day (March 25th) is a very desirable period, especially in cases where the entry on the holding dates from that time.

A valuation should be carefully made of the live and dead stock, and of those acts of husbandry for which the farmer would be entitled to make a claim as an outgoing tenant.

On the College Farm the stock is estimated by a regular valuer, but in ordinary cases the occupier himself will be able to arrive unassisted at a very close approximation to the truth.

The amount of the valuation, together with any floating cash, represents the real capital of the farmer, and forms a starting

point for the farm account. Many people are satisfied with estimating merely the value of the stock and crop, considering that the acts of husbandry will come to about the same amount each year, and may therefore be dispensed with; such a plan may do very well when a farm is in good order and regularly cropped, but at the commencement of the occupation of neglected land, when a large outlay has to be made, the accurate valuation of all legitimate expenses is the only means by which the farmer can judge whether he has been acting judiciously and is likely to see a return for his money. Tillages, moreover, are so easily valued by any practical man, who has kept memoranda of the nature and amount of work performed in each field, that I would strongly recommend the young farmer never to neglect this part of the balance sheet.

It is satisfactory to be able to point to any particular year, and show that, whilst the money returns were smaller than usual, the farm was indebted for a large sum in acts of husbandry, which, if properly performed, laid the foundation for large returns hereafter. I annex a few notes from a Farmer's Valuation Field-book. (See page 125.)

From this it will be evident that, to make a valuation of this sort, practical knowledge sufficient to form a judgment of the value of work, and care in keeping a record of the amount of work performed, for which an outgoing tenant would be entitled to receive compensation, constitute the necessary requirements.

The rough draft of this inventory may be made in the farmer's pocket *Memorandum-book*, which should be accurately and neatly kept, as it is the source from whence we look for the material of our accounts.

All the transactions that take place either at market or in our fields and walks must be noted at once.

Much of the farmer's business being done in the open air, receipts for money are seldom given, formal contracts rarely drawn up, therefore the memorandum of the transaction made on the spot, with the date affixed, is most useful; and should the matter be of much importance, or should there be any reason to anticipate that the contracting party may be inclined to run from his word, it is a good plan to obtain his signature at the foot of the memorandum, after having read it over to him. That note and your oath would be quite sufficient evidence in a court of justice.

Arrangements for measure work should also be duly noted, and indeed a memorandum of every transaction that can be referred to subsequently should be made when it takes place.

It is very important to enter at once in the Memorandum-book

the receipt or payment of small sums, for it is these trifling matters which are most easily lost sight of, and cause so much worry and useless labour.

Inventory and Valuation of the Live and Dead Stock, Corn, Hay, Straw, Acts of Husbandry, Implements, &c. &c., taken March 26, 1857.

a. r. p.		£.	s.	d.
	Sheep.			
	70 Down Wethers (2 Tooth) *at* 45/			
	48 Wether Tegs, Long Wool *at* 54/			
	61 Ewe Tegs .. „ .. *at* 52/			
	12 Barren Ewes, fat .. .. *at* 60/			
	111 Ewes and Lambs .. .. *at* 66/			
	51 Ewes and double Lambs *at* 72/6			
	15 Ram Tegs .. .. *at* 95/			
	3 Old Rams .. .. .. *at* £8. 10/	1079	2	6
	371			
	Corn, Hay, and Straw. (£. s. d.)			
	6 Wheat Ricks, the Straw, Chaff, and cavings of ditto; a quantity of Wheat in Granary 315 0 0			
	2 Oat-ricks, and quantity in granary .. 93 0 0			
	1 Stack of Beans and Quantity 72 18 0			
	Quantity of Straw 30 9 6			
	„ of Hay 26 10 0	537	17	6
	Implements. (£. s. d.)			
	1 Crosskill Roller 10 0 0			
	3 Iron Ploughs by Howard, 2 by Ransome 3 7 6			
	1 Cultivator by Coleman .. 9 10 0			
	1 Do. by Ducie .. 5 6 0			
	&c. &c. &c.			
	Acts of Husbandry.			
	In Field No 1. .. .. Wheat. (£. s. d.)			
20 3 4	Clover Ley, once ploughed with Skim, *at* 9/ an acre 9 6 11			
	3 times Harrowed, *at* 10*d.* = 2/6 an acre 2 11 11			
	Drilling with 4-horse Drill, *at* 1/6 do. 1 11 2			
	Seed Wheat, 7 pecks per acre, *at* 7/ a bushel, 12/3 .. .. 12 14 5¾			
	Bird-keeping, *at* 1/ an acre 1 0 9¼			
	Pulling Docks, *at* 9*d.* 0 15 7			
	Once Crosskill rolled, *at* 1/6 .. .. 1 11 2	29	12	0

It is very annoying to a methodical man to find his money either short or in excess of the pen-and-ink balance.

From what has been stated you will see that, whilst many of the memoranda go into the accounts, other things die in the Memorandum-book: it is a good plan either to tick off the entries as they are carried to the accounts, or draw a line through them, as the eye will then catch at a glance any item that has been missed, or that requires attention.

In some systems of accounts the Memorandum-book and Journal are combined, but this is a serious mistake, since the *Journal* is a book which ought to receive the transactions from the Memorandum-book, and be kept with neatness; it should be in fact a daily record of transactions capable of being referred to at any period, since from this and the Cash-book we derive the materials for making out the Ledger accounts.

Generally the Journal contains a money column, and the amounts of all transactions, whether they are money paid or received, or simply contracts for sales or purchases, are entered consecutively in this column under the day on which they occur. The following example will show the kind of book commonly used:—

JOURNAL.

Folio Ledger.	Heading in Ledger.		£.	s.	d.
		TUESDAY, March 28, 1857.			
18/40	Smith to Sheep.	Sold Mr. T. Smith 24 fat Wether Sheep, *at* 56/	67	4	0
26	Food purchased, to Cash.	Bought and paid Mr. Jones for 10 qrs. Beans, *at* 40/ a qr.	20	0	0
40	Cash to Sheep.	Killed 1 Giddy teg. Sold same to Labourers *at* 4*d.* a lb. 60 lbs.	1	0	0
23	Cash to Pigs.	Sold and Received of Jacob Mills for 6 fat Hogs; 76 score 8 lbs. *at* 10/ a score	38	4	0

The specimen above will serve to give a correct idea of the form in which the *Journal* may be kept. You will see that it is an important book, as the entries are here prepared for the

Ledger. A very little practice will enable the farmer to prepare the entries correctly for the Ledger—I mean to fill up the 2nd column properly.

Besides this book we must have the *Cash-book*, in which all actual cash receipts or payments find a place either on the Dr. or Cr. side, according to their nature: and here, before proceeding farther, I will endeavour to explain the meaning of the two terms Dr. and Cr. sides of an account, the not understanding which causes, I believe, more confusion and perplexity than any other part of accounts.

In every account there are supposed to be two sides: one for all that comes in, the other for all that goes out. It may be an account of money or an account of goods, as "wheat" or "sheep;" but the account is said to be Dr. "to" all that comes in, Cr. "by" all that goes out, be it money or be it goods. In like manner a separate account may be kept for work done. Thus the labour account is charged as Dr. to all the money paid for wages, which represents the value received or brought in in the form of work; and if the farmer does work for any purpose unconnected with his farm, as, for instance, haulage of timber on an estate, the labour account should take credit for this as work "gone out" from the farm—that is, the charge against the farm for labour would be diminished by that amount which is presumed to be paid for in some other way. The Dr. side of an account, as you open the book, should always be on the left-hand side, the Cr. on the right; it saves confusion to have a rule of this sort.

The account, Cash in the case before us, is indebted to all sums or items that are given to it, and, therefore, whenever a transaction, whatever it may be, involves the immediate receipt of money, it confers a benefit on the account, that is, it increases Cash; the Cash Account is therefore indebted to some one or something, and consequently the item must appear on its Dr. side.

When money is paid away the cash is diminished; the Cash Account, therefore, is Creditor by the transaction, it takes credit for having given up money; and thus we may at once know to which side an item belongs, according to whether it adds to or takes from the account.

Let us take a very simple example: I receive 20*l.* from a butcher for a fat ox, sold to him, say a month ago; Cash or myself, for Cash represents the farmer, is Debtor to the *butcher;* but suppose I pay away 15*l.* for a week's labour, then the "*labour*" account is indebted, or Debtor, and Cash takes Credit for paying away the 15*l.*, and is Creditor. Let us place these two accounts on the opposite sides of an imaginary Cash Book.

CASH BOOK.

Dr							*Cr*		
		£.	*s.*	*d.*			£.	*s.*	*d.*
1857. Nov. 20	To Thomas Smith.. ..	20	0	0	1857. Nov. 22	By Weekly Labour, &c. ..	15	0	0

Applying the same reasoning to the several departments into which a farmer's business is divided, we shall readily learn on which side an entry should be placed. Let us take the Sheep Account: suppose I purchase and pay for 100 sheep at Weyhill Fair, then the Sheep Account must be indebted to Cash, and Cash must be credited by the Sheep Account, for sheep have come in and money has gone out; but if I sell 50 sheep at a fair and receive money for them, the sheep take credit for having parted with 50 of their number, whilst Cash is indebted, having received the amount of their sale, and so on with every other account.

In some systems of farm accounts it is recommended, instead of keeping a Journal, in which all transactions, whether sales or purchases, are recorded, to have a separate book for Sales and Purchases, and this plan has, I believe, received the sanction of the Royal Agricultural Society. The following are examples of these books:—

DAY BOOK.

1856.		*Sales.*		£.	*s.*	*d.*
Oct. 1		Sold Mr. Johnsey.				
	367	1 Empty Sow .. .. *at* 70/	3 10 0			
	—	1 Casualty Store Pig *at* 23/	1 3 0			
	383	1 Casualty Ewe Lamb *at* 20/	1 0 0			
				5	13	0
,, 4		Sold Mrs. Tidmarsh.				
	324	1 gallon of Tarling Wheat, *at* 8*d*. ..	0 0 8	0	0	8
,, 7		Sold Mr. Casey.				
	367	A Store Pig, *at* 37/	1 17 0	1	17	0

DAY BOOK.

1856.		*Purchases*	£.	s.	d.
Sept. 1		Bought of Mr. Moore.			
	383	A Shearling Ram, bred by Mr. Brain, *at* 5½ guineas	5	15	6
,,		Bought of Peter Matthews and Son.			
	334	15 Cwt. of Guano .. .. *at* £13. 10/	10	2	6
,, 11		Bought of R. Allen.			
	268	1 Sack of fine Pollards .. *at* 12/ } 2 ,, of Bran .. .. *at* 5/6 }	1	3	6

There are serious objections to this plan, both as entailing a great deal of labour, and leaving one entirely in the dark as to whether the items represented are paid for at the time, or are credit accounts, or have in part been liquidated ; indeed I believe it is based upon the principle, which may be correct in theory but is quite erroneous in practice, that a farmer's business is entirely a ready-money one.

Without the aid of a Cash-book, and a great deal of trouble, it would be impossible for an accountant to show the amount of debts to or from the estate. Besides, in posting to the Ledger we must gather our material from three books instead of one, or two at most, which would be the case in the ordinary use of the Journal. *The Journal* which is kept at the Royal Agricultural College combines three books, which are generally kept separate in mercantile business:—*the Day-book*, recording from day to day every transaction, whether cash or credit, that takes place in the day ;—*the Journal Proper*, in which every item is journalized, or prepared for the Ledger, a small column on the left-hand side being left on purpose for the Ledger headings ;—and a *Cash-book ;* two out of the three money columns representing the Dr. and Cr. sides of a common Cash-book.

The advantages of using a book of this kind, over either the common Journal or the distinct books for sales and purchases, is, I think, very great. In the first place, the distinction between a cash and credit transaction is seen at a glance, on account of the entries being made in different columns ; and, secondly, every item that goes to make up the Ledger will be found in this book, and nothing else but this one book is required to complete a farm account. It is less probable that any item will be missed and remain unposted, or that any item will be placed to a wrong account. As fast as the entries are transmitted into the Ledger the number of the folio is placed on the extreme

left of the page, showing at once the transactions that are posted. The combination of books here described would be objectionable in large concerns where a great many entries occur, but a farmer has comparatively few entries, and I have frequently posted a month's work in the Journal in from two to three hours. Once a month will be quite often enough to post, and then, commencing at the first entry that has no folio mark against it, we carry it to its respective account, and look down the Ledger headings for any others belonging to the same; and, having done this, return to the second entry in the Journal, and so on until all is posted.

The entries in the Journal are all connected with cash in some way or other. No mere memorandum finds admission there; for such purposes we have the pocket Memorandum-book already described, and if a more permanent book is deemed necessary, it is easily procured.

The Journal, being a daily record of transactions, is the important book in case of any dispute, and should therefore be kept in as clear and intelligible a form as possible: indeed, in keeping accounts, we should always bear in mind that one great object should be to have everything in such an intelligible form, that, in case of death, any one taking up the accounts could at a glance see the position of affairs. It will assist us in obtaining this desirable result, if at the end of each year we take the bills from the file, fold them up neatly, endorse and number them, placing the same number against the entry of payment in the Journal, and tying them up in a bundle. Any one looking over the accounts will thus be enabled to place his hand upon any particular bill and examine its contents.

In every case where we are managing for another, some such system is indispensable, and the slight trouble it causes is amply repaid by the satisfaction of feeling that your accounts are ready at a moment's notice, and are so clear that no explanation is required from you.

I proceed to give a specimen of *the Journal*, the *second book* that will be required for Farm Accounts, taking a page from our own, in order afterwards to trace the entries into the Ledger, when explaining the nature of that book. (See p. 131.)

In the following specimens there happen to be no actual ready-money transactions; they are either entries of sales and purchases, or of money received and paid for articles, the sale or purchase of which would be found duly recorded at an earlier page of the Journal.

If, however, we purchase and pay for an article, or sell and receive, the form of entry is different and explicit. Thus: Bought and paid Mr. Robinson for 1 ton of superphosphate—

Sold

Folio in Ledger.	Headings in Ledger.	JOURNAL FOR 1857.	Transactions, *Not Cash.* £.	s.	d.	Cash Received. £.	s.	d.	*Cash Paid.* £.	s.	d.
		MONDAY, October 20th.									
313 / 362	Slatter, or (SP) to Barley.	Sold Thos. Slatter {30 qrs. Golden Melon Barley / 40 qrs. Humphreys' Imperial} 48/6	169	15	0						
		TUESDAY, October 21st. £. s. d.									
272 / 118	Food purchased to J. Lane.	Bought of John Lane {8 sack Bran, *at* 5/6 .. .. 2 4 0 / 9 score Pollards, *at* 1/4 .. 0 12 0}	2	16	0						
226 / 342	Miss Brown to Wheat.	Sold Miss Brown 4 bushels of Tailing Wheat, *at* 5/	1	0	0						
		THURSDAY, October 23rd.									
376	Cash to Bank.	To Gloucestershire Banking Company	..	..	..	20	0	0			
		FRIDAY, October 24th.									
322	Labour to Cash.	By Weekly Labour	..	..	..	..	..	..	19	3	11
		SATURDAY, October 25th.									
313 / 342	Hudson to Wheat.	Sold H. Hudson 60 bushels of Spalding Wheat for Seed, *at* 8/ a bushel	24	0	0						
342 / 333	Wheat, Dr. to T. & R. Brown.	Bought a hogshead of Messrs. T. and R. Brown, for Dressing Seed Wheat in	..	10	0						
363 / 334	College to Manure.	Sold The College, for Garden, 4 loads of Manure, *at* 3/6 ..	..	14	0						
		MONDAY, October 27th.									
118	Cash to Lane.	To John Lane (Wheat)	..	..	..	22	8	0			
303	Charges to Cash.	By less Chap-money	..	..	..	..	..	..	..	1	0
313	Cash to Slatter.	To Thomas Slatter (on account of Barley)..	..	..	..	72	15	0			
303	Charges to Cash.	By less Chap-money	..	..	..	..	..	..	..	3	0
376	Bank to Cash.	By Gloucestershire Banking Company	..	..	..	..	..	..	113	3	0
		WEDNESDAY, October 29th.									
313 / 362	Cripps to Barley.	Sold F. Cripps and Company, 24 qrs. Barley, *at* 48/	57	12	0						
104	Cash to Trotman.	To John Trotman (fat Hog)	..	..	..	6	19	0			
313 / 303	Clarke (or SP) to Charges.	Sold G. Clarke a Grate from Coates' cottage	..	10	0						
						122	2	0	132	10	11

Sold and received of John Lane for 20 quarters of wheat. The Ledger headings are simple: in the first case, Manures Dr. to Cash—in the second case, Cash Dr. to Wheat.

The name of the party to a bargain in a ready-money transaction never goes beyond the Journal, because it is not required. The sale or purchase has been recorded under its proper heading in the Ledger, and cash has been debited or credited, as the case may be.

Many of the farmer's transactions will in reality be of this simple nature, and, in cases where payment is customary in a week or so, it is not worth while to make credit transactions of them. The entry may remain in the pocket memorandum-book until the money is paid, when it may be entered in the Journal, or rather the Cash-book, as a ready-money business. In the case of a credit account, say for the sale of 20 sheep, to T. Jones, T. Jones (or Sundry Persons, if he is only an occasional purchaser) is indebted or debtor to Sheep, which are credited, and when in due course the money is paid, the entry is merely to T. Jones, and the heading Cash Dr. to S. Persons.

Jones's account in the Ledger, which was debited at the date of purchase, is now credited at the date of payment and balances. The eye separates at one glance the credit from the cash transactions, and he must be very stupid indeed who makes any mistake as to the columns.

As the cash account is kept so perfectly distinct in the Journal, it is considered unnecessary to repeat it in the Ledger, and this accounts for there being no folio numbers against Cash. With regard to the folio numbers, it is worthy of notice that when they refer to a debtor account they are placed above the line, and under the line when the item appears on the creditor side of the Ledger heading which they represent.

The Ledger.—This is the *third book* that requires our notice, and it is a very important one, enabling us to divide our transactions under various heads, which the diversified nature of a farmer's business appears to require.

Without the use of this book we could only say by reference to the Cash-book that such a sum of money has been spent and so much received, and that from the valuation more or less value of stock remained on the ground, therefore the total profit or loss was so much—a very incomplete sort of balance-sheet truly, for we must always bear in mind that the great object of accounts is to show the separate returns upon the different branches of a farmer's stock and crop.

We may increase or diminish the number of heads of account at pleasure. Thus, for instance, a man may place under one general heading all kinds of corn sold, whilst another will

prefer to have a separate account for each description of grain. Live stock, again, may be arranged together or kept separate. Where the entries are few, classing them together would not be so very objectionable, since they could readily be separated if it were desired; but on large or good-sized farms we shall do well to have the following headings in our Ledger:—

Wheat, Barley, Oats, Beans, Peas, and any other description of corn which may be produced and sold. Horned Cattle, Sheep, Pigs, Horses, and Poultry. Roots sold, Hay and Straw sold, Food purchased. Seeds purchased. Manures purchased. Implements. Coals. Various Creditors, either under separate Ledger headings, or collected together, as Sundry Persons, according to the amount of business each is likely to transact. Rent. Rates and Taxes. Manual Labour. Permanent improvements. Miscellaneous. Profit and Loss, &c. &c. The following examples will show the way in which the Ledger is kept. (See page 134.)

This Table will convey an idea of how Ledger entries are made. (The small column preceding the money spaces is useful as referring at once to the Journal for fuller particulars than can conveniently be entered into the Ledger.) The Food, Seeds, and Manures Purchased accounts are very useful, especially the two former. It would be next to impossible to say beforehand exactly the proportion of a purchased article that each kind of stock will consume, and therefore it is all carried at first to a stores account, and then at the end of the year, or as often as the farmer deems advisable, the account is balanced by receiving credit for the proportion consumed during the year by the different kinds of stock, the material for this adjustment being taken from a granary or corn account, to be spoken of hereafter.

Now this is quite a simple sort of Ledger, which merely shows the gross returns or expenditure under each heading, and does not go into the details which some have advocated.

But every day's experience more thoroughly convinces me that a complete system of double entry cannot be applied successfully to farm accounts. I do not mean to say that it is impossible to pursue it, but that to do so entails an enormous increase of work, without any equivalent advantage. By double entry I mean an exact account—Dr. and Cr.—against every field or other item.

Now to do this we must, in the first place, analyse the Labour Journal, that is, separate every shilling laid out, and charge it to the various accounts for the benefit of which it was done, and post these amounts regularly into the Ledger, to the Dr. of the field or crop, and the Cr. of labour.

The field, then, in the Ledger will contain, on the Dr. side, first

LEDGER.

Dr Date.	*Sundry Persons.*	Folio Journal.	£.	s.	d.	Date.	*Sundry Persons.*	Folio Journal.	£.	s.	d. Cr
1857.	T. SLATTER.					1857.	T. SLATTER.				
Oct. 20	To Barley	20	169	15	0	Oct. 27	By Cash	20	72	15	0
	JOHN LANE.						JOHN LANE.				
Sept. 21	To Wheat	16	22	8	0	Oct. 21	By Food Purchased	20	2	16	0
						,, 27	By Cash	,,	22	8	0
	MISS BROWN.						MISS BROWN.				
Oct. 21	To Wheat	20	1	0	0						
	H. HUDSON.						H. HUDSON.				
Oct. 25	To Wheat	20	24	0	0						
	T. AND R. BROWN.						T. AND R. BROWN.				
							By Wheat (*Hogshead*)	20	0	10	0
	F. CRIPPS.						F. CRIPPS.				
Oct. 29	To Barley 24 qrs.	20	57	12	0						
Dr	*Barley.*					1857.	*Barley.*				Cr
						Oct. 20	By T. Slatter, 70 qrs. Barley *at* 48/6	20	169	15	0
						,, 29	By F. Cripps, 24 qrs. Barley *at* 48/		57	12	0
1857.	*Wheat.*					1857.	*Wheat.*				
Oct. 25	To T. and R. Brown 1 hogshead	20	0	10	0	Oct. 20	By Miss Brown, 4 bush. Tail ..	20	1	0	0
						,, 25	By H. Hudson, 60 bush. Seed, *at* 8/	20	24	0	0

first the amount of tillages, as valued at the beginning of the year; next the value of the seed-corn deposited in it, and every expense both of manual and horse-labour, &c. &c; the amount of rent, rates, and taxes. The contra will show the value of crop raised, and the acts of tillage performed for the benefit of the next year.

Now all this looks exceedingly well on paper if you have a clerk to do nothing else; but, beyond appearances, it is, I contend, of little value. Nay, I positively believe that such accounts will very frequently confuse rather than enlighten, and by giving false returns tend to injure the judgment. If you really could do any series of operations solely for the benefit of one crop or one year, then this plan of accounts would be more feasible; but a judicious system of management always presupposes a certain rotation of crops, and in this rotation one crop is so connected with another, and the work or money expended in one year is so beneficial to a crop or two beyond, that it is impossible to say how much of the value of labour is to be charged to the present year.

Take the turnip-fallow, for example. Very often, if this be foul, it will cost 4*l.* to 5*l.*, or even 6*l.* an acre to produce a crop of roots, the same roots being worth for consumption on the ground from 3*l.* to 4*l.* Is the turnip-crop to be charged with the whole of this large expenditure? Certainly not, if we aim at accuracy; and yet how much ought it to bear, and how is the remainder to be divided amongst the succeeding crops? It is clear to me that we must take our management as a whole, and throw the expenses over the rotation and compare with the produce; and therefore, instead of having a complicated system of double entry, which involves much useless work, I would keep the accounts as simply as described, but at the same time have such a Labour Journal that it would be perfectly easy, if thought desirable at any time, to ascertain the cost of any particular crop or experiment that might be going on.

To show more clearly the complication of farm accounts kept solely by double entry, I would refer to a horse-account, as it would be kept by Lord Meath's system of accounts.

These accounts were made public in a lecture before the Royal Agricultural Society of Ireland by Mr. Hamilton, some three years ago. The account is for farm-horses. On the Dr. side are columns for oats, barley, beans, hay, straw, potatoes, parsnips, carrots, and other food-produce of the farm, food from the store-room or purchased food, and every other expense; whilst the Cr. side is made up of the quantity of work done by horses in the different fields throughout the year.

Now, in order for this account to be of the least value, every article consumed by the horses must be accurately valued or

weighed, a market price put upon it, and the various accounts to which each article belongs credited weekly with the consumption by the horses. For instance, the hay account would be credited by so many trusses or hundredweights consumed by horses.

Returning for a moment to the case of a field: supposing it to bear swedes, partly consumed on the ground by sheep, partly carted to the farm. We must value the quantities of tons for each purpose, and charge to the cattle and sheep at a consuming price. Just see the difficulty and complicated nature of such accounts.

It is impossible that men of ordinary abilities, and with much on their hands, could keep such accounts, and even when done, the probability is that the valuations would be inaccurate, and we should have a fictitious profit appearing on some accounts and an unnatural loss on others.

Well, indeed, may practical men despair of keeping accounts, when such unpractical systems are brought before their notice.

In order that an insight may be obtained at any period of the year of the state of the farm balance, a stock account in the Ledger is to be recommended, and at the end of every month the amount of sales, whether for cash or credit, should be entered on the Cr. side of this account, and all purchases or expenses incurred, whether paid for or not, on the Dr. side. The particulars will be readily procurable from the Journal at a very trifling amount of labour, and it becomes a very useful account, not only showing the exact position of the receipts and payments from month to month, but at the end of the year furnishes us with a check upon the accuracy of the Ledger accounts, as it should show, in one amount, the same result as these various accounts together. By heading the Dr. side with the gross valuation at the commencement of the year, and the Cr. side with the gross valuation at the end of the year, this stock account furnishes a balance-sheet.

If any farmers think that the keeping a Ledger entails too much time, and are satisfied with seeing the result as a whole without caring for the particulars of profit and loss on each branch of trade, a statement of this sort may be very easily extracted from the Journal and the Labour-book.

Indeed, rent, &c., labour, food and manures purchased, and live stock bought, being deducted, the remainder of the outgoings may be entered as sundry payments. With regard to the Cr. side, live stock and corn sold will form the principal receipts, and the other items may appear in a lump as sundry receipts. Such a statement may be made at the end of the year, or monthly; indeed, a little amplification of the stock account would answer all the purpose. But I cannot recommend the substitution of such a statement for the regular Ledger.

In proceeding to consider the *Labour Journal*, you will see at once how perfectly easy a matter it would be at any time to ascertain the exact labour expended upon any particular item of a farmer's stock, or crop, without the labour of a regular weekly analysis. The book that we keep for registering the daily work of each man is divided into two parts—the first and largest portion being ruled so as to admit the men's names and their work each day, the total number of days, the rate per day, and the total amounts of each man's work; the remainder being kept for the memoranda of contract work, the amounts for which are entered along with the day labour as they are paid.

A man or company of men enter upon a job, say mowing wheat; every week they draw a certain sum on account, which is entered against the names in the first part of the book, and when the work is measured and settled for, all the particulars which could not conveniently be entered for want of space in the Weekly Labour, are carried to this part of the book, and are referred to by attaching the folio of the page to the name of the man or company in the Weekly Labour.

This will appear more clearly from the examples we proceed to give. Each field, instead of having some long unintelligible name, which it would take some time for students to learn, has a certain number corresponding with similar numbers on a printed pocket map. Size of Labour Book, 17 in. deep by 10½ in. wide, when shut. (See pages 138 and 139.)

I have not considered it necessary to fill up the whole of the week, sufficient being done to show the nature of this important book, which should be carefully filled up daily, otherwise the memory will not retain the way in which the labour has been employed.

I would refer you for a moment to the form of Labour Journal proposed by Morton in his article "Farm Accounts," in the 'Cyclopædia of Agriculture,' and compare the relative advantages of the two systems. The plan which he proposes is a very ingenious one, but open, I conceive, to serious objections. He adheres to the plan of analyzing the labour and charging the various crops, &c., with the results. In order to save labour, he substitutes numbers for the various Ledger accounts, and thus against each man's name, and under the different days of the week, we find not an account of what work was done, but a number which refers to the Ledger account which is indebted or Dr. for the day's work. This will be more easily understood by an example of a portion of a week. (See p. 140.)

If we do keep double-entry accounts, and intend to charge each item of stock and crop with the amount of labour, there is no system which has yet been made public that will bear comparison with

	Names.	Saturday.	Monday.	Tuesday.
Teams ..	Geo. Clarke ..	Horsekeeper, &c.,	.. ..	.. ..
,, ..	Thos. Mecham	[2])Carting Carrots from 3 and 5.*	[2] Ploughing 19	[1] Carting [3]Stock to Show.
,, ..	C. Bond	[2] Ploughing 11	[2] Carting Carrots, 3 and 5.	[2] ,, 3 and 5
				[1])$\frac{1}{2}$,, .. 19
,, ..	G. Wooley ..	Absent	[2] Ploughing 19	$\frac{1}{2}$,, .. 12
		[2])$\frac{1}{2}$Ploughing,3 and 5		[2] $\frac{1}{2}$,, .. 19
,, ..	Z. Redhead ..	$\frac{1}{2}$,, .. 19	[2] ,, 19	$\frac{1}{2}$,, .. 12
		[2])$\frac{1}{2}$Ploughing,3 and 5		
,, ..	A. Fowler ..	$\frac{1}{2}$,, .. 19	[2] Carting Carrots, 3 and 5.	[2] ,, 3 and 5
£. s. d. 3 16 0	T. Herbert ..	[2])Carting Carrots, 3 and 5.	[1] Carting Carrots, 3 and 5.	[1]Jobbing Hurdles, &c.
Labourers	G. Hayes ..	Stacking Carrots	Cleaning Engine, &c.	Carting Carrots ..
(6)	W. Goddard ..	Getting up Carrots, 3 and 5.	Stacking ditto ..	Covering ditto ..
	W. Walker ..	.. ..	Carting ditto ..	.. ..
	John Brunsdon	.. ..		
	C. Compton ..	.. ..		
	C. Mormon ..	.. ..		
	H. Field	.. ..		
£. s. d. 5 5 6	C. Morgan ..	Stacking Carrots		
Boys ..	Hayes			
	Arkill			
11/0	Walker			
Women ..	Mrs. Cobb ..			
	Mrs. Evans ..			
Stock ..	D. Hilchman ..	Cowman	.. ..	.. ..
,, ...	Boy Smith ..	Helping ditto ..	.. ..	.. ..
,, ...	J. Reynolds ..	Shepherd	.. ..	.. ..
,, ...	Mabbett	Assistant ditto ..	.. ..	.. ..
,, ...	Robins	Assistant ditto ..	.. ..	.. ..
,, ...	Ritchins	Cleaning and heap	ing Swedes 19 ..	.. ..
£2 18 0	Goddard, Boy	Feeding Pigs ..	.. ..	.. ..
Carpenter &	J. Wakefield ..	.. ..	.. ..	.. ..
Blacksmith £. s. d. 1 11 4	G. Cooke	.. ..	.. ..	.. ..

* Field numbered on the Map (3 & 5).

Wednesday.	Thursday.	Friday.	No. of Days.	Rate per Day.	£.	s.	d.	Remarks.
.. ..	.. ..	.. ..	6	2/2	0	13	0	
2)½ Cleaning Yards ½ Carting Carrots, 3 and 5.	[2] Ploughing 12	[2] 12	6	2/	0	12	0	
[2] Ploughing 12	[2] ,, .. 12	[2] 12	6	2/	0	12	0	
[2] ,, .. 12	[2] ,, .. 12	[2] 12	5	2/	0	10	0	
[1] Cleaning Yards	Ploughing 12	[2] 12	6	2/	0	12	0	
[2] Ploughing 12	[2] ,, .. 12	 12	6	1/8	0	10	0	
[1] Cleaning Yards	Jobbing .. 12	Taking in Barley ½ ditto	6	/10	0	5	0	
Winnowing Barley	Engineer	½ Winnowing Barley ½ ditto	6	2/	0	12	0	
		Balance of Carrots†	..	..	1	0	2	
Ditto Mangolds ..	,,	½ Taking in Barley ½ ,,	5	1/10	0	9	2	
Covering Mangolds	,, ..	½ Taking in Barley	5	1/10	0	9	2	
.. ..	.. ..	.. ..	6	2/2	0	13	0	
.. ..	.. ..	.. ..	6	1/	0	6	0	
.. ..	.. ..	.. ..	6	2/	0	12	0	
.. ..	.. ..	.. ..	6	1/3	0	7	6	
.. ..	.. ..	.. ..	6	1/3	0	7	6	
.. ..	.. ..	.. ..	6	1/0	0	5	0	
.. ..	.. ..	.. ..	6	1/10	0	5	0	
.. ..	.. ..	.. ..	6	3/	0	18	0	
.. ..	.. ..	.. ..	5	2/8	0	13	4	
					14	7	2	

† See specimen of "Particulars of Measure-work," p. 142.

Weekly Wages.		Monday.	Tuesday.	Wednesday.*	Thursday.	Friday.	Saturday.	No. 1. Wheat.	No. 2. Clover.	No. 3. Carrots.	No. 4. Mangolds.	No. 5. Horses.	No. 6. Cattle.	No. 7. Sheep.	Total.	Observations.
								£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	
15/	1st Ploughman	1	1	*1	1	3	3	0 10 0	..	0 5 0	..	..	..	..	0 15 0	* Thrasher, No. 15 riek, 132 bushels of head corn.
13/	2nd ,, ..	4	6	1	4	4	4	0 2 2	..	..	0 8 8	..	0 2 2	..	0 13 0	
13/	3rd ,, ..	5	1	4	1	4	4	0 4 4	..	..	0 6 6	0 2 2	..	..	0 13 0	
12/	Cowman ..	6	6	6	6	6	6	..	..	..	..	..	0 12 0	..	0 12 0	
10/	Shepherd ..	7	7	7	7	7	7	..	..	..	..	..	..	0 10 0	0 10 0	
Women 5/ per week.	Morgan ..	..	..	1	1	4	4	0 1 8	..	..	0 1 8	..	..	..	0 3 4	
	Williams ..	..	..	1	1	4	4	0 1 8	..	..	0 1 8	..	..	..	0 3 4	
		..	..	..	..	..	..	0 19 10	..	0 5 0	0 18 6	0 2 2	0 14 2	0 10 0	3 9 8	

with this, as far as the perfect simplicity and economy of figures that distinguish it goes; but it is very difficult to say a year hence what was the nature of the work performed.

The first ploughman, for instance, was employed during four days on the wheat crop; but, farther than that on the Wednesday he was thrashing, we have no clue as to whether he was rolling, hoeing, or even drilling late spring wheat.

Surely one great object of a labour account is to be able to look back at any future period, and compare notes as to the operations that were carried on at certain periods.

Again, in the example, the work is all arranged in full days, but in practice it very frequently happens that the men are employed portions only of the day at each job, and these minutiæ would render the analysis far more tedious.

A difficulty presents itself in the case of labour performed upon ground intended for a crop of swedes—for example, long beforehand, say the previous autumn. The farmer may and often is compelled to alter his cropping, on account of the season or the demand, &c.; and a field ploughed up for swedes, and the labour debited to that account, may be cropped with mangold, with peas, beans, or half-a-dozen things. A transfer must be made in such cases, which all adds to the complexity of the scheme.

These are some of the reasons why I would not adopt the Labour Book of Morton, but greatly prefer the one I have described, in reference to which I proceed to give an example of that part of it intended for the particulars of contract or measure work. (See page 142.)

The total amount of each week's labour is entered in the Journal, just as any other cash payment would appear. These are the four books, then, which are necessary to be kept:—

1. The pocket Memorandum Book.
2. The Journal and Cash Book.
3. The Ledger.
4. The Labour Book.

Besides these, two other books are very useful, and though not actually essential to the cash part of the business, we can hardly do without them. I refer to the Granary and Stock Accounts.

The *Granary Book* is a small book, of convenient size to go into the pocket, in which is an entry for each kind of food consumed, or grain sold or bought, and whatever quantities are given out for consumption are noted here, and the proportion used by different kinds of stock. At the end of the year it is a simple matter to ascertain the proportion and value of the different kinds of food consumed, and charge the Stock accounts accordingly.

The

MEMORANDA OF TASK-WORK.

6) (6

	£.	s.	d.
GODDARD AND WALKER.			
Trimming Hedges and raking up Thorns			
2645 poles *at* 6/ a 100 poles	7	18	9
Received on account:—			
s. d.			
Oct. 2 .. .. 10 0			
,, 9 .. .. 16 6			
,, 16 .. .. 22 0			
,, 23 .. .. 22 0			
Nov. 6 .. .. 11 0			
Oct. 30 .. .. 22 0	5	3	6
Balance paid, Nov. 7/57	2	15	3
W. GODDARD AND CO.			
Raising and cleaning Carrots in No. 3 and 5.			
3a. 2r. 35p. *at* 28/	5	4	2
Nov. 20th on account	4	4	0
Balance paid, Nov. 27/57	1	0	2

The granary should be kept locked, and the corn be given out once a-week.

Let us take as an example the Wheat account:—

Date.	Entries.			Sold.			Used for Seed.			Used for Pigs.			In Store.		
	Qrs.	Bu.		Qrs.	Bu.	P.	Qrs.	Bu.	P.	Qrs.	Bu.	P.	Qrs.	Bu.	P.
Nov. 20	36	0	From No 1.	33	4	0	..	..	..	2	4	0	0	0	0
Dec. 10	5	0	Bought for Seed.	..	..	..	4	5	2	..	..	..	0	2	2

At the end of the year it is easy to find out the quantity of wheat, barley, beans, &c., that pigs have consumed; and, valuing it at a reasonable rate, the Pig account must be debited, whilst the various Corn accounts are credited.

By this book we see at a glance what corn horses have consumed. It is also valuable as affording a check upon the honesty of men, and for this purpose stock should be taken a little oftener than is usually done, so that any deficiency would be readily seen.

The *Stock Book* contains memoranda of the different kinds of live stock, the pedigrees of the cattle, and times when calves, litters of pigs, or lambs are due. It is a very useful book. Each kind of stock has a portion of the book set apart for its own uses.

These, then, are all the books that a farmer needs, and, after a little practice, I feel certain that any one who has had an ordinary education would find no difficulty in keeping them. Modifications may be made, according to circumstances; but the book which claims your particular attention in this system is the *Journal*, as its use will, I believe, save labour and give a degree of clearness to your accounts not to be gained by any other plan with which I am acquainted.

VI.—*On the Management of Breeding Cattle.* By Edward Bowly.

Prize Essay.

To ensure success in the breeding of cattle it is of the first importance to procure animals possessing good forms, and those characteristics which denote sound constitutions. To describe these qualities I cannot do better than refer to a letter written on this subject by Major Rudd to an American friend, many years

since, on pure Short-horns, which is equally applicable to any breed of cattle at the present time:—

"A small and fine head, a capacious chest, the shoulders lying back in the body, the ribs round and barrel-like, the back straight from the neck to the top of the tail, the loins wide, the hind quarters long and straight, the twist full and deep, the bones small, and offal light; to these points of shape must be added the great essential of good handling, which is the index of the propensity to fatten. A knowledge of handling cannot be communicated by letter, and is acquired only by practice; it consists in a peculiar feel of the flesh under the skin. The skin should be rather loose, and under it the flesh should feel rather soft, yet firm and elastic; when a beast has this particular handling, and has long soft silky hair, it indicates the propensity to fatten."

The point which I consider of most consequence is to secure a deep and capacious chest, as animals possessing largely-developed lungs will fatten more quickly, and have greater strength of constitution, than others not so favoured.

Having provided the right sort of animals, it requires great care and observation in the breeder to keep them in a healthy and thriving condition, always having nature in view; and while we screen them from the great variations in our climate, we must be careful to avoid extremes of any kind. I believe all breeding stock do much better in winter in open sheds with yards attached, where they may feed, than in entirely-closed houses. It is desirable, however, to avoid keeping too many animals together in one yard, lest the stronger should tyrannise over the weaker, and keep them from obtaining their proper share of food and shelter. I consider that four (selecting those which agree best together) are as many as should occupy one shed and yard. Cattle should be provided with shade in the summer, and in very hot days, when the flies are troublesome, should be taken in; they will not feed during the heat of the day, and the frantic way in which they often run about cannot but be injurious, particularly to those in calf. Pure water is also most essential to the well-being of cattle. The young animals require the most care; while their forms are being developed any check is injurious, and on their management during the three first years the success of the breeder will principally depend.

Having commenced with these remarks, I will now confine myself as much as possible to my own experience as a breeder of pure Short-horns for more than twenty years.

My early calves (those which drop from December to the end of February) I allow to suck the cows for a fortnight, then take them off and give them as much as they will drink of skimmed milk and thick gruel made from boiled linseed in equal proportions, twice a day; as soon as they are inclined to eat, I supply them with oilcake, carrots, and hay; when three months old I reduce the milk and linseed to once a day, and in three weeks

afterwards discontinue it altogether, continuing the food till they are turned out to grass. Then I give them 2 lbs. of oilcake daily, which I continue in addition to their other food for 12 months, that is, till they go to grass the following year; in July and August of which year they are served by the bull, so that they will calve the year following just before going to grass, when they will be about two years and four months old. I allow their calves to run with them during the summer; when four or five months old I take the calves away and dry the dams, by which means the heifers get a much longer rest than the older cows before they calve again, thereby encouraging their growth, and under this system they can produce calves at an early age without interfering with the full development of their forms.

Some are of opinion that heifers should not calve till they are three years old. My experience does not warrant this view of the subject. Not to multiply instances, I may mention that a heifer of mine calved at fifteen months and two weeks old, the calf being at its full time. This animal gained a first premium as a two-year-old in-calf heifer, and a second premium the following year as a cow in milk, when there were an unusual number of competitors, and I afterwards sold her at a high price to go abroad. The sire of the calf was a bull calf about six months old, sucking a cow in the same field with the then heifer calf; they were neither of them a week over six months old; the connexion was witnessed by my cowman, or I should have scarcely thought it possible. I have been careful since never to allow the bull and heifer calves to be within reach of each other after four months old.

Those calves which drop late in March and during the summer months I allow to run with cows, often purchasing nurses for the purpose; it being desirable to remove them from their dams, as cows being sucked by calves will not always take the bull so soon as those milked by hand; these later calves are served by the bull at the same age as the early ones.

I never give any artificial food to animals after they have completed their growth, and not often after eighteen months old, up to which age I consider it is profitable to the breeder, whether of Short-horns or any other breed, to give a moderate quantity of oil-cake, thereby increasing the size of the animal and the value of the manure.

My cows have grass alone during the summer, late in the autumn a little hay at night and in the morning, and hay and roots when in milk in the winter, the dry cattle having pulped roots and straw-chaff during that season. This comparatively new mode of feeding cattle is one of the greatest improvements of the present day: formerly, when cattle were fed on roots and straw,

they ate too many of the former and not sufficient of the latter; by thus mixing the two we induce them to eat the proper proportions of each, and they do much better, with little more than half the old quantity of roots. I have several dry cows now in excellent condition, being fed on 45 lbs. of pulped swedes and a bushel and a half of straw-chaff each daily, with no other food whatever. My calves of last year, now eleven to thirteen months old, are in a very thriving condition with 28 lbs. of pulped swedes, one bushel of straw-chaff, with 2 lbs. of oil-cake each daily. I have the chaff and roots mixed only a short time before they are given to the animals; if allowed to remain in a heap two or three days the mass will heat, and some persons maintain that it is best to give it to the cattle in this warm state. I have found no advantage in it myself, and I consider it therefore best avoided, as it may sometimes tend to acidity not favourable to the health of the stock.

I have never tried the system of steaming and giving the food warm to the cattle; but a friend of mine, Mr. Anthony Bubb, of Witcombe Court, near Gloucester, has made several experiments in feeding cattle and pigs with steamed and unsteamed food, and has found no advantage from the former, except that, when hay and straw-chaff is used alone it is rendered more palatable, particularly if the hay is of inferior quality.

I consider straw objectionable food, unless accompanied by roots or a small quantity of oil-cake; it often causes obstruction in the second stomach, which is one of the most dangerous maladies we have to contend with in cows.

It will be seen that, in making the above observations, I have supposed the calves to be dropped indifferently at all times of the year: when they are all kept for breeding purposes there is no objection to this; but where cows are kept principally with a view to cheese-making, it is important that they should calve nearly at the same time, that is, within a month or six weeks of each other. Under such circumstances breeding is generally only a secondary consideration; in some cases none of the calves are reared, and in most only a small proportion, and then only the earlier ones. To such cases I consider my system with the early calves well adapted, except that, instead of allowing the heifers' first calves to run with them, they should be taken away and the heifers milked by hand; not only because on a dairy-farm such late calves would not usually be reared, but because the heifer would probably take the bull earlier than if sucked by the calf. Most good breeders produce a calf every eleven months, so that these heifers would soon come in to calve sufficiently near the time of the general herd.

Should it at any time be an object to rear any of these later

calves, I should keep them on skim-milk and linseed, as I do my early calves; but as they will not be so forward and strong before winter as my later calves, which suck their dams, I should not bring them in to calve till they are two years and eight or nine months old, when they would also come in with the general herd. I may here remark, as I perhaps have not sufficiently explained before, that late calves, if they are brought in at the same age as early ones, require more generous treatment, being too young to take advantage of grass when it is in its most nutritious state.

I have no faith in the idea which I have sometimes heard expressed, that "roughing" calves (which means exposing them to cold and hunger) makes them hardy. On the contrary, it has the effect of weakening their constitutions; and this system pursued towards the young stock for two or three generations will ruin the best breed of cattle in the country; the offspring after this time will have lost all the quality, early maturity, and propensity to fatten of their ancestors, and it will require years of the greatest care to recover what is thus lost. On the other hand, it is very injurious to force young animals, although it *may* be necessary in those individuals which are intended to compete for prizes. The tendency of such a system is to curtail their usefulness as breeding animals, for, though most of them so forced will breed, there is of course more risk in calving them, their milking properties are greatly lessened, from those vessels intended by nature for the supply of milk being coated with fat, and they decay prematurely, and have all the marks of age upon them at seven or eight, whereas I have bred from cows not so forced up to twenty-two years of age. Nor is there any real reason for forcing show-animals; for judges can fully appreciate the merits of cattle without their being so extremely fat as breeding-stock are now exhibited at nearly all our shows.

To show that all cattle-breeders of name are not advocates of the high-feeding system, I can say that, when I had the pleasure of attending the late Mr. Bates's sale with the late Earl of Ducie, the herd was brought to the hammer only in ordinary condition, and some of the heifer-calves were really too poor; yet this did not seem to detract from their value in the eyes of breeders, for the prices they produced were thought at that time very high. Lord Ducie, as I well remember, gave upwards of 1000 guineas for six animals (one being a calf), and how fully he was justified in so doing was abundantly proved by the unprecedented prices they and their produce realised at the sale of his own herd, when the bull which he purchased for 200 guineas was sold for 700, and many others in proportion. The Earl of Ducie himself was so opposed to overfeeding breeding animals that he carried his views almost to an extreme; and all who attended the celebrated Tort-

worth sale must remember that they were only in what would be called fair working condition, and I never remember a purchaser at either of these sales expressing any disappointment in the animals he bought; all, I believe, that were said to be in calf proved to be so; whereas, at many Short-horn sales, where the animals have been forced to a high state of condition, complaints have been numerous of animals said to be in calf not proving so, and of other misfortunes happening to them.

In the selection of a bull so much depends on the character of the female he is required for, that it is almost impossible to lay down a rule on paper. To secure, however, a decidedly masculine character it is better he should be too coarse than too fine. The man who at present possesses an ordinary herd of cows has a very simple course to pursue; if he will procure a well-descended bull from any improved breed he will make great advance; even if the bull is not a first-rate animal himself the offspring will partake most of the character of the purest and oldest blood, on whichever side it may be. The produce of a pure bull and an ordinary cow will often surpass in many points the high-bred sire; but it would be wrong to use a cross-bred bull, even if he were very good, for his stock would almost invariably be inferior to himself.

In proof of the general result of using a pure-bred sire, I knew a man who began breeding with a very inferior herd of cattle, the greater portion being the black Welsh, and, by using pure Short-horn bulls for three or four generations, he produced from them a very respectable herd of Short-horns, and entirely lost the black colour; yet I have no doubt that if he had ventured to use one of the bulls bred by himself the black colour of his Welsh ancestor would have appeared again.

On this subject I quote a passage from the writings of the late Mr. Gisborne, who, in speaking of the risk incurred by using a male of doubtful pedigree, however promising in appearance, says:—

"We have before us a letter from the late Earl Spencer to a friend, in which he says, 'Your cross will not justify a very high-priced bull; but in order to secure you against *anything monstrous* in his stock, you must ascertain that you have several generations of real good blood.' With such incidents a breeder of horses is familiar. He selects a bay mare with black legs, and unites her with a male having the same characteristics. If the produce should be chesnut, with a bald face, and what the dealers call white stockings, we can assure him of sympathy from many fellow-sufferers."

When a herd of cattle are approaching perfection the greatest care and judgment are required; having reached this point, there is always a disposition to degenerate; the best judges are often deceived as to the effect of crosses, and acute obser-

vation is necessary to discover any error in time to prevent its extending.

What is called breeding in and in will no doubt ensure greater certainty as to the produce, but, beyond one or two generations, it is objectionable; although you may secure a more perfect form, you will lose in size and weaken the constitution. Many men of the greatest experience in breeding animals are opposed to this system; amongst them I may mention the late Sir John Sebright, who made the experiment with a variety of animals, in all of which he discovered that it was injurious. Its advocates sometimes bring forward the wild animals as an instance that close breeding does not cause degeneracy: Sir John says in answer to this that—"Nature provides for herself in this way, that the greater proportion of the weak animals die before coming to maturity, and that the most robust males serve the largest number of females," so that the work of propagation is chiefly carried on by the stronger and superior animals, as much in fact as if they were selected.

The term breeding in and in is very indefinite, and not sufficiently understood, some applying it to all near relations, whereas, strictly speaking, it should only be applied to animals of precisely the same blood, as own brother and sister. Now, the daughter is only half the blood of the father, and the son only half that of the mother, and breeding from such relationship as this last, if watched with care, may be carried to a moderate extent without injury, and perhaps with some advantage. But we must remember that, in the present day, good male animals are so easily procured that no man need be driven to breed in and in because he cannot procure a suitable cross.

With regard to diseases I have generally given my own directions as to medical treatment, taking as my guide Skellett's work 'On the Diseases, &c., of Cattle,' and I am glad of this opportunity to bear my testimony to its value to the cowkeeper, from the clear manner in which the author describes maladies and directs the treatment of cows especially during gestation.

Cleanliness should be attended to, and cattle should occasionally be scrubbed with a brush made of whalebone, particularly on those parts which cannot be easily reached with the tongue; young animals are often much annoyed with lice, these should be destroyed the moment they appear, a strong decoction of tobacco being the most simple mode. Neither should a slight indisposition be neglected, and if a cow refuses her food, or gives less milk than usual, I am always suspicious of evil, and my cowman has drenches at hand composed of 1 lb. of salts, and an ounce each of ginger and nitre, with instructions to give one to any animal which fails in appetite, or in the supply of milk, or appears

in any way out of order; this simple dose can do no harm under any circumstances, and its early application tends to prevent serious illness.

The infantine disorders of cattle should have the attention of the breeder, with a view to their prevention. The first malady to which a calf is liable is a scour, which comes on when two or three days old, and is often very fatal: it arises from great acidity of stomach. In the post-mortem examination, the milk will be found formed into a hard mass, which can only with difficulty be cut with a knife, and unless this can be dissolved and passed off by the influence of alkalies and other medicines, death will speedily ensue. I have restored calves suffering from this complaint by giving them magnesia and rhubarb, of each a teaspoonful, and twenty grains of grey powder, repeated every six hours. In this affection, as in most others, prevention is better than cure, and accordingly I have of late given to each calf, as soon as dropped and before sucking the cow, rhubarb, magnesia, and castor oil, of each a teaspoonful, repeating it if necessary; giving the cow at the same time a cleansing drench, which is too well known to every druggist to need any description. Since I have adopted this mode of treatment I have not lost a calf from this disease. Scour will attack calves at a more advanced age; it is generally the consequence of cold, and, if taken in time, four to six ounces of salts, a quarter of an ounce of nitre, and the same of ginger, will remove the cause, which is generally some obstruction in the stomachs or bowels. I believe the astringent applications used in this complaint are often injurious.

Calves are not unfrequently attacked with the "husk," so called from the constant short cough which accompanies this complaint. It makes its appearance in the autumn, when they are eight or ten months old. It is caused by living animals attached to the windpipe, and extending, if not checked, to the lungs. My calves have never, with the exception of one year, suffered from this disease, and then only slightly, and it disappeared after a daily application of tar to their noses, the imbibing the effluvia of which is said to destroy the worms: this receipt is quite insufficient in severe cases. There are many modes of treatment which may prove successful if taken in time. I am assured by men of experience that the most certain cure is half a teaspoonful of chopped savin, with half-a-pint of strong decoction of wormwood, given to each calf for three successive mornings after fasting the night, then waiting three mornings, and then repeating this treatment, suspending the doses again for the same time, then giving three more, making in the whole nine doses; which, it is said, will relieve the poor animals from their sufferings. I think this affection is often occasioned by the calves not

being provided with sufficiently nutritious food after the milk is discontinued, and also from keeping too many together, as I have found large herds suffer more from husk than smaller ones.

The only other serious complaint peculiar to young cattle is murrain, or quarter-evil, treated of by Skellett under "black leg or quarter." This attacks them in the spring or early part of the summer, when they are about eighteen or twenty months old. I have never had more than one well-defined case myself. Some land is said to engender this disease, and I believe justly so; I think, however, it more frequently arises from the animals not having thriven well during some portion of the winter, and then thriving too rapidly when they go to grass. Few animals are saved after the malady has developed itself. Various ridiculous expedients are used for its prevention, amongst them, inoculating the tail with garlic, &c.; also what is called plugging, which consists in putting a seton, most commonly through the dewlap: this may prove of some use.* As there is no doubt the malady proceeds from fulness of blood, aperient medicines, given at short intervals during the spring, will prove of advantage.

The general treatment I have here described I have found eminently calculated "to ensure regular fecundity and successful gestation." In all the cows I have had in calf during twenty-two years, I have only had two per cent. which did not bring their calves to the full time, and I have been fortunate in always having my cows prove in calf in seasonable time. I have for nearly twenty years possessed the knowledge of a remedy which is said to be certain to secure conception in a cow, but, fortunately, I have never had occasion to put it in practice till last year. It consists in removing the clitoris from the vulva, which may either be done with caustic or the knife: the latter was used in this case. The cow operated upon produced twins in July, 1856, and was served by the bull within the usual time, but did not stand, and became what is called a "perpetual buller," that is, always in a state to take the bull, which is generally considered a most hopeless case. She is a very favourite cow, and I was unwilling to subject her to what I supposed would be considerable suffering; therefore I delayed the operation till last July, and was glad to find that it caused little pain or inconvenience. It was performed immediately after the cow had been served by the bull; she took the bull again in three weeks, and has since produced a heifer-calf at the proper time. I gained my information on this subject from the late Mr. Pegler, of Stow-on-the-Wold, a man of great experience and judgment in all agricultural matters; and he observed it in practice during an

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* This practice is in constant use in many herds, and so far as my own observation and experience go, is perfectly efficacious.—Ed.

agricultural tour in Ireland, where it was considered certain to produce the desired effect. If it can be fully relied on (and this case of my own is so far confirmatory), it is of great value to the breeder. I believe it is little known in this country, as I have often mentioned it to those who have inspected my herd, and found few who had before heard of such a mode of treatment.

The terms of this Essay provide also that we should state "the causes which operate adversely to regular fecundity and successful gestation in particular seasons." This is exceedingly difficult to do, as such causes are for the most part atmospheric; we can protect our animals from the extremes of heat and cold, and from the elements, but there are states of the atmosphere which, though they undoubtedly tend to engender diseases and irregularities in man and beast, yet are in no way reached by our perceptions, and against which consequently we are unable to provide.

I think, however, that disorders in cattle are sometimes attributed to the influence of seasons which arise from the oversight of the breeder. I remember, some years ago, a tenant in the vale of Berkeley left his farm because the majority of his cows slipped their calves every year. His successor removed a pond in the yard into which some drains entered, and from which the cows were supplied with water, and his cows ceased to suffer from abortion. My experience on this head is, fortunately, so very limited, that I have but little to say from that source. I remember that abortion prevailed in one particular season in the late Earl of Ducie's herd, and that it was hinted by some that the cause of it might be found in the rye grass of the Tortworth pastures, which during that season was extensively ergotised, ergot of rye being known to produce abortion in some cases; but I think no person of experience would ever believe that such a small quantity as could be swallowed in that way would be sufficiently strong to act on the nerves of a ruminating animal, whatever might be the case with a non-ruminant, and I know that the Noble Lord himself had no belief that the rye grass had anything to do with it. As to the question of abortion being contagious, I do not believe it to be so in the medical sense of the word; but there is no doubt but that one case of abortion may produce others, and this I believe arises from that sort of nervous sympathy which exists between cows, instances of which will be readily remembered by all experienced persons. Therefore I hold it to be advisable, when a cow has slipped her calf, to separate her from others that may be in calf at the time, and I have no doubt but that the separation will tend to prevent the spread of the mischief.

In the above remarks I have given my own experience as to the management of a herd of breeding-cattle, and I have de-

scribed the diet, the treatment, and conditions which I conceive best calculated to ensure regular fecundity and successful gestation. In my own case, and with my own herd, it will be seen that they have been peculiarly so. What I have observed and heard of other herds, where a different system has been pursued, has only confirmed me in my view as to the correctness of my own. At the same time there are undoubtedly peculiar seasons, during which the course of nature as regards the produce of animals is unaccountably exceptional, and we talk familiarly, and not unreasonably, of a "bad lambing season," and a "bad calving season," as we should of a wet or a dry season. In some seasons there is a most unaccountable predominance in the number of one sex over the other. The observant author of the 'Journal of a Naturalist' notes this, and says "The most remarkable instance that I remember was in 1825. How far it extended I do not know, but for many miles round us we had in that year scarcely any female calves born." Circumstances like this must be decidedly adverse to fecundity, and yet it is not possible to prevent them. I can but therefore allude to this and analogous cases as remarkable facts of interest and importance to breeders of cattle, but not, so far as my judgment goes, to be prevented or provided against by any means which I have not detailed.

Siddington House, Cirencester.

VII.—*Experiments upon Swedes, with Remarks on the Manures employed.* By Augustus Voelcker.

In 1855 I published in this Journal some experiments upon Swedish turnips, grown on a calcareous soil with guano, superphosphate, bone-dust, night-soil manure, dissolved coprolites, nut-refuse-cake, and several other fertilizers. The object I had then in view was to ascertain practically the comparative economic merits of some artificial manures, which at that time were much recommended as turnip manures. The result of these trials proved that whilst one of the fertilizers, namely, the British economical manure, which I regret to say is still sold in many parts of England, turned out to be a complete failure, and others produced no remunerative crops, superphosphate of lime greatly excelled all other manures employed in the experiments, not even Peruvian guano excepted. The superphosphate used in these experiments was made on our farm by dissolving bone-dust in one-third of oil of vitriol, and consequently contained a considerable quantity of animal nitrogenized matter, which, on decomposition, readily yielded ammonia. On land yielding, when unmanured, 5 tons 4 cwt. of roots, topped and tailed, 2*l.*-worth of home-made super-

phosphate gave an increase of 8 tons 8 cwt. 16 lbs., whilst the same amount of money expended in bone-dust yielded only an increase of 3 tons 12 cwt.

Guano produced 2 tons less of swedes per acre than home-made superphosphate—a difference, considering the small crop furnished by the unmanured land, which is considerable. On the other hand, dissolved coprolites gave an increase of 6 tons 8 cwt., or very nearly the same increase as guano alone; and a mixture of guano and dissolved coprolites an increase of 7 tons 12 cwt. 16 lbs. The purely mineral superphosphate, made by dissolving coprolites in acid, thus produced a less favourable effect than the bone-superphosphate, but, when added to guano, dissolved coprolites increased the efficacy of the latter as a turnip manure. The produce obtained with other manures poor in phosphate fell short of the crops raised with phosphatic manures.

The legitimate conclusions which may be drawn from these field experiments are—

1. That on the particular soil, in the season in which the experiments were made, and the quantities of manures employed, guano was a less economical manure for swedes than bone-superphosphate.

2. That phosphatic manures greatly increased the yield of the root-crop, and much more so than other kinds of artificials.

3. That the form in which the phosphates were employed very much indeed affected the result, since superphosphate gave more than 2½ times as much increase per acre as an equal money value of bone-dust.

4. That a purely mineral phosphate, when dissolved in acid and perfectly free from ammonia, under favourable circumstances may produce as large a return as guano, a manure rich in ammonia.

It does not appear, however, from these experiments whether ammonia had any share in the final result or not. The fact that bone-superphosphate, containing from 2 to 2½ per cent. of ammonia, gave a much larger return than the mineral superphosphate, and also the equally important fact that the addition of a small quantity of guano to dissolved coprolites had a very beneficial effect, would seem to indicate that ammonia, in moderate proportion, is a desirable fertilizing ingredient of a turnip manure. A critical examination of these facts, however, I think neither proves nor discountenances the conclusion that ammonia has had a beneficial effect in the recorded experiments; for when comparing the effects of bone-superphosphate with dissolved coprolites, no account was taken of the proportion of soluble phosphate contained in each. I have since ascertained that the dissolved coprolites contained most of the phosphate in an insoluble

state, not near enough acid having been employed for dissolving the coprolite powder. Indeed the coprolite manure contained but little soluble phosphate; and as insoluble phosphate, in the shape of coprolite powder, has as little effect upon vegetation as sand, whilst the insoluble phosphates in bones, partially decomposed by acid, unquestionably are sufficiently available to produce an immediate effect on the turnip crop,—the difference in the result obtained by dissolved bones and dissolved coprolites, therefore, may have been due to the larger amount of available phosphates, and not to the ammonia contained in the former. On the other hand, the addition of some guano to dissolved coprolites having produced a beneficial effect, it may be inferred that the ammonia in the guano produced this effect; but since Peruvian guano contains both soluble phosphates and bone-earth, in a highly finely-divided state, it may be maintained with equal force that the additional produce resulted from the additional quantity of available phosphates in guano. In short, my former experiments, of which a detailed account will be found in vol. xvi., of this Journal, are not calculated to decide the question whether or not ammonia can be dispensed with as a manuring constituent in a turnip manure, nor do they show that superphosphate is a more economical manure for roots than guano; for it is quite possible that an excess of ammonia will do harm to turnips, whilst a small quantity is likely to benefit the same crop, provided available phosphates are present at the same time. It also occurs to me that the assimilation of phosphates may be much facilitated by the presence of a quantity of ammonia not large enough to injure the roots. In other words, it is possible that whilst 2*l*.-worth of guano per acre produces a less favourable result than 2*l*.-worth of dissolved bones, 1*l*.-worth of guano per acre may be found a more economical dressing, and 10*s*.-worth of guano and 10*s*.-worth of superphosphate may give a more favourable result than either guano or superphosphate separately.

It may appear a simple matter to ascertain the comparative value of ammonia as a fertilizing agent for root-crops, but this is not the case. Notwithstanding all the experiments that have been made with various ammoniacal and phosphatic manures, our knowledge on this subject is so imperfect, that those who are best acquainted with the experience of good farmers in different parts of England will hesitate to give a definite answer when the question is asked, Is ammonia a useful or necessary fertilizing constituent in a turnip manure? I do not think we are at present in a position to give a satisfactory answer to this question, for the simple reason that, important as it is, it has not yet been sufficiently investigated in all its bearings. The contradictory testimony of equally good and intelligent agriculturists—some

maintaining that ammonia has a decidedly beneficial effect upon turnips, others that it is of no use whatever for that crop—shows plainly enough that we have still a good deal to learn before it can be decided on what soils and under what system of cultivation ammonia can be dispensed with in a turnip manure, and what the conditions are that render the direct supply of ammoniacal matters to roots necessary or desirable.

We hear constant discussions as to whether guano is better than superphosphate, or whether a mixture of guano and superphosphate should be used; and these discussions are never brought to a successful issue, simply, I believe, because we are unacquainted with the precise circumstances under which ammonia exerts a beneficial or contrary action upon root-crops. The question of the superiority of guano or superphosphate mainly hinges upon this: Can I dispense with the expensive ammonia, and yet get a good crop of roots? I have no hesitation in saying that there are many soils upon which excellent root-crops may be grown without the direct application of ammoniacal manures, and that at the present time a great deal of ammonia, the most expensive constituent of guano, is, comparatively speaking, lost, and therefore guano itself to a great extent wasted, in the cultivation of turnips.

In support of these assertions, I may mention the fact that phosphatic guanos that are comparatively poor in ammonia, such as Saldanha-bay or Ichaboe, have been found to yield much larger crops of turnips than Peruvian guano, which contains a great deal more ammonia; likewise the fact that a mixture of superphosphate and guano generally answers better than guano alone. Again, I may mention that excellent crops of turnips are now grown every year, which are manured with nothing else but superphosphate, made exclusively from bone-ash or mineral phosphates.

It is, indeed, worthy of notice, that at least 90 per cent. of all the artificial manures that are now offered for sale, whatever their name may be, are in reality superphosphates, and that most of these manures contain either no appreciable amount of nitrogenized matters, or, at any rate, are very poor in nitrogen or ammonia. It is not likely that an intelligent class of men like the manufacturers of artificial manures, would shorten the supply of nitrogenized or ammoniacal matters in turnip manures, if they had not found out by experience that they can give more satisfaction to the farmer by supplying him for his turnips with a manure rich in available phosphates and poor or destitute of nitrogen, than by sending manure poor in phosphates and containing much ammonia.

It is certainly remarkable that, in nine cases out of ten, even

those artificials, which, like nitro-phosphate, ammonia-phosphate, blood-manure, &c., convey the idea of manures rich in nitrogen or ammonia, when prepared for turnips, hardly contain any nitrogen. Still I am informed, on good authority, that there are many soils on which the very cheapest manure that can possibly be used for turnips is guano.

How can these contradictory facts be reconciled? I believe only when the subject is thoroughly investigated, without direct reference to the immediate advantages that will result from the investigations to the farmer. It is by laborious, long-continued, and expensive field experiments, and purely theoretical investigations, like those referring to the assimilation of nitrogen by plants, and carried out at present in a masterly manner in Mr. Lawes's laboratory at Rothamsted, that, after all, most practical questions have to be answered. The establishment of a single truth in science, especially if it refers to living organisms, is often the work of the lifetime of a man. Many excellent experiments, whether made in the field or in the laboratory—experiments conceived in a philosophical spirit, and carried out by men accustomed to perform accurate researches with the most praiseworthy industry, perseverance, and personal expense, too—have had the fate of being denounced as unpractical. Such experiments necessarily must appear quite mysterious to the uninitiated; but, after all, they are much more likely definitely to settle important practical questions than many so-called practical trials, made for the special information of the farmer.

With a view of throwing some light on the action of ammonia on root-crops, more especially on swedes, I made some experiments in 1856 and 1857, and have now the pleasure of laying the results of those experiments before the Royal Agricultural Society. I would notice particularly that my object was not to ascertain how large a crop of turnips I could obtain by the application of certain mixed manures, but to determine, if possible, whether on our farm and the soils in our neighbourhood we can dispense with the use of ammonia or not, and what manuring constituents are likely to be of the greatest benefit to this root-crop.

Experiments upon Swedes in 1856.

Skirving's Liverpool Swede.

The field on which the following experiments were made was sown with rye in the autumn of 1855, to afford an early bite for our sheep; but the green rye having partially failed, the field was ploughed up early in spring and repeatedly worked with the cultivator and harrows before the seed was sown.

The surface soil is brashy, thin and poor; when separated from the limestones which render it apparently lighter, it constitutes a stiffish clay-marl, which in wet weather is very tenacious and heavy, and in warm weather dries into hard masses which do not readily fall into powder. The subsoil is a stiff tenacious clay; the field has been well drained.

Like most soils in the neighbourhood of Cirencester, it contains a considerable quantity of lime. It was also richer in organic matter than most arable soils on our farm. It will be seen likewise, by inspecting the following analysis of this soil, that it contained a good deal of soluble silica and much clay, since the insoluble silicious matters consist almost entirely of clay.

Composition of Soil of Experimental Field, No. 22, on the Royal Agricultural College Farm, Cirencester.

Moisture, when analysed	4·72
Organic matter and water of combination	11·03
Oxides of iron	9·98
Alumina	6·06
Carbonate of lime	12·10
Sulphate of lime	·75
Alkalies and magnesia (determined by loss)	1·43
Soluble silica (soluble in dilute caustic potash)	17·93
Insoluble siliceous matters (chiefly clay)	36·00
	100·00

The experimental field was carefully measured out, and after rejecting the headlands, divided into 12 parts of $\frac{1}{20}$th of an acre each. These plots were arranged side by side in continuous rows of 4 rows each. The different manuring matters were sown by hand, and the seed drilled in on the 21st of June. Two of the experimental plots were left unmanured for the purpose of ascertaining the natural produce of the land, and also whether it was uniform or not. The produce of both unmanured plots sufficiently proved the equal agricultural capability of the experimental field. Although it was my principal object to ascertain whether or not ammonia could be dispensed with for turnips on this field, and which other manuring constituents produced the most marked effect on this crop, I was anxious to ascertain how far the natural produce could be raised by a good dressing of well-rotten farmyard manure, and therefore applied to one plot farmyard manure at the rate of 15 tons per acre.

In all field experiments, at least one, or better two plots, should be left unmanured; if possible one plot also should receive a good dressing of farmyard manure. By doing this an insight into the natural condition and agricultural capabilities of the soil may be obtained; and the results of trials with special manures will be interpreted in a more satisfactory manner than is the case

when such experimental plots are omitted in a series of field experiments.

My twelve experimental plots were treated in regard to manure as follows :—

			At the rate of per Acre.
To Plot I.	was applied	well *rotten farmyard manure*	15 tons.
,, II.	,, ,,	*gypsum*	6 cwt.
,, III.	,, ,,	bone-ash dissolved in sulphuric acid	6 cwt.
,, IV.	,, ,,	sulphate of ammonia	6 cwt.
,, V.	,, ,,	bone-ash dissolved in sulphuric acid, 6 cwt. sulphate of ammonia .. .. .. 6 cwt. together ———	12 cwt.
,, VI.	,, ,,	bone-ash, dissolved in sulphuric acid	12 cwt.
,, VII.	,, ,,	sulphate of potash	6 cwt.
,, VIII.	,, ,,	Nothing.	
,, IX.	,, ,,	crystallised sulphate of soda	12 cwt.
,, X.	,, ,,	bone-ash, dissolved in acid .. .. 6 cwt. sulphate of potash .. .. 6 cwt. sulphate of ammonia .. .. .. 6 cwt. together ———	18 cwt.
,, XI.	,, ,,	bone-ash dissolved in sulphuric acid	3 cwt.
,, XII.	,, ,,	Nothing.	

These manuring matters were all finely powdered and thoroughly mixed with ashes, in order to secure their more uniform distribution over the land.

When bone-ash is dissolved in sulphuric acid, soluble phosphate and gypsum are produced. Soluble phosphate alone cannot readily be used in field trials. The influence of the gypsum in the dissolved bone-ash upon the produce in these experiments, however, is determined by the dressing of gypsum applied to Plot No. II. At the same time we have here sulphuric acid in combination with ammonia, as well as with soda and with potash, and thus the means of comparing the manurial efficacy of sulphuric acid with that of phosphoric acid. To apply sulphuric acid diluted with water would have been to no purpose; for since the soil contained rather more than 12 per cent. of carbonate of lime, gypsum would have been formed immediately on putting free sulphuric acid on the land. Since turnips contain a good deal of sulphur, it is not unlikely that sulphates will be beneficial to that crop, at least on soils naturally deficient in sulphate of lime, the usual state in which sulphuric acid occurs in soils. In these experiments we have sulphuric acid in combination with lime as a difficult soluble salt with an earthy base, and sulphuric acid in combination with the three alkalies—potash, soda, and ammonia. With the three last-mentioned substances sulphuric acid forms salts more or less readily soluble in water. It might therefore have been expected that sulphuric acid, if at all capable of showing any specific effect on turnips,

would have produced a marked effect in one or other of these combinations.

I have carefully analysed the bone-ash dissolved in sulphuric acid, and obtained the following analytical results:—

Water	32·80
Organic matter	·13
Biphosphate of lime	18·49
Equal to bone-earth, rendered soluble by acid ..	(28·80)
Insoluble phosphates	6·43
Hydrated sulphate of lime	38·39
Alkaline salts	1·94
Sand	1·82
	100·00

The swedes were taken up in the last week of November, topped and tailed, and the whole produce of each plot weighed.

Table, showing the Produce of trimmed Swedes of Experimental Plots, calculated per Acre, as well as the Increase over the unmanured part of Field.

Plot		Produce per Acre. tons.	cwts.	lbs.	Increase per Acre. tons.	cwts.	lbs.	
I.	15 tons of farmyard manure yielded	7	16	38	5	0	75	
II.	6 cwts. of gypsum yielded	2	1	45	0	14	30	decrease.
III.	6 cwts. of boneash, dissolved in sulphuric acid, yielded	8	3	38	5	7	40	
IV.	6 cwts. of sulphate of ammonia yielded	2	12	51	0	3	24	decrease.
V.	6 cwts. of sulphate of ammonia, and 6 cwts. of boneash, dissolved in acid, yielded	8	6	41	5	10	78	
VI.	12 cwts. of bone-ash, dissolved in acid, yielded	8	12	90	5	17	15	
VII.	6 cwts. of sulphate of potash yielded	2	10	0	0	5	75	decrease.
VIII.	Nothing yielded	3	0	19	..	..		
IX.	12 cwts. of crystallised sulphate of soda yielded	3	6	9	0	10	46	
X.	6 cwts. of dissolved bone-ash, and 6 cwts. of sulphate of ammonia, and 6 cwts. of sulphate of potash yielded	6	17	6	4	2	43	
XI.	3 cwts. of dissolved bone-ash yielded	7	19	51	5	4	88	
XII.	Nothing yielded	2	11	19	..	..		

In constructing this Table, the natural produce of the experimental field was taken at 2 tons 15 cwt. 75 lbs., being the average of the two unmanured plots Nos. VIII. and XII.

In explanation of the results of these field trials, I beg to offer the following observations :—

1. It will be seen that only those plots yielded an increase which contained phosphates ; the other manuring constituents either had no effect upon the turnip crop, or slightly diminished it.

2. On comparing the produce of No. I. with that of No. XI., it will be seen that 3 cwt. of superphosphate, made from bone-ash and sulphuric acid, and containing no appreciable quantity of nitrogen, produced as good a result as 15 tons of well-rotten farmyard manure. This is an important fact, well worth the serious consideration of the farmer; and though I would not be understood as saying in general terms that I consider 3 cwt. of good superphosphate to be worth, for the turnip crop, as much as 15 tons of well-rotten dung, I believe there are many soils in England which require nothing else but 2 or 3 cwt. of good superphosphate drilled in at the time of sowing, with liquid manure drill, in order to yield an abundant crop of turnips.

3. It is worthy of notice that 6 cwt. of bone-ash superphosphate hardly produced a heavier crop than 3 cwt. ; and also that 12 cwt. of the same superphosphate yielded only 17 cwt. and 76 lbs. more than a dressing with 3 cwt. There are soils on which experience has shown that a large dressing of superphosphate produces a more favourable result than a more scanty supply of this fertilizer. I believe this to be the case with most light and sandy soils. But in the majority of instances, I have no hesitation in saying that much more superphosphate is applied to the land than is really required to produce the maximum effect which this fertilizer is capable of producing. This remark, however, applies only to superior superphosphates, rich in soluble phosphate of lime, and not to the majority of superphosphates which find their way into the hands of the farmer ; for I regret to say there have been sold this season many samples so poor in soluble phosphate, that 2 cwt. per acre can produce but little effect ; 10 or 12 cwt. of such superphosphates certainly will prove superior in efficacy to 6 or 8 cwt. of the same.

4. Gypsum had no effect whatever on the turnip crop, a result which was to be expected upon a soil naturally containing nearly $\frac{3}{4}$ per cent. of sulphate of lime. Indeed, gypsum yielded 14 cwt. less turnips per acre than the average produce of the unmanured plots, but I do not think it had an injurious effect, and ascribe the slightly-diminished produce of plot No. II. to purely accidental causes.

5. It will also be seen that neither sulphate of ammonia nor sulphate of potash had any effect, and that sulphate of soda produced but a small increase. The inefficacy of these sulphates

appears to prove satisfactorily that sulphuric acid was not wanted in the experimental field.

6. As sulphate of ammonia proved inefficacious when used by itself, or in conjunction with soluble phosphates, either the ammonia had no effect upon the swedes and might have been dispensed with, or the quantity of sulphate of ammonia was too large, and had injured the young plant, and to some extent had retarded its progress. I believe both to have been the case. Further experiments will show whether or not nitrogen, applied in other forms than that of ammonia, has a better effect upon roots, and also whether or not the result would have been different, if sulphate of ammonia had been more sparingly used. One series of experiments is totally unfit to dispose of so important a question as that of the utility of nitrogen for turnips. Without entering therefore further into the theoretical aspect of this question, I would observe, that sulphate of ammonia greatly retarded the germination of the turnip seed, and, instead of rapidly pushing on the young plant, it kept the plant back, and throughout the experimental period the turnips on plot No. IV. were far behind all the others. When devising the experiment with sulphate of ammonia, I expected to see a luxuriant development of the leaves at the expense of the bulbs, but, to my great astonishment, the leaves of the turnips on No. IV. were much smaller than those of the adjoining plots Nos. III. and V., and certainly not larger than the leaves of the unmanured turnips. In No. V., on the other hand, I observed, to some extent, the effects which are generally ascribed to ammoniacal manures. The leaves in No. V. had a much darker appearance than in other plots, not dressed with sulphate of ammonia, and the plants on this plot looked on the whole the most luxuriant. It is thus plain that ammoniacal salts like sulphate of ammonia are only leaf-producing manures, if they find in the soil or manure the proper mineral constituents which are essential to the formation of the leaves. My experience on this subject is not mature enough to speak with confidence on the relative value of ammonia for root-crops generally, and its functions in relation to other cultivated crops; but I can well conceive that on well-cultivated soils, rich in those mineral matters required by root-crops, ammoniacal manures may be used with advantage even for root-crops; whilst on poor thin soils, deficient in available phosphates, ammonia will do more harm than good. In the experiments here recorded, sulphate of ammonia used by itself had no effect whatever on the development of turnip-tops; used in conjunction with soluble phosphate it appeared to favour the growth of leaves. I regret not having weighed the tops, to verify this observation in the field.

7. On comparing the produce of plot X. with that of No. XI., it will be seen that 3 cwt. of bone-ash superphosphate produced nearly a ton more roots than a mixture of 6 cwt. of the same superphosphate with 6 cwt. of sulphate of ammonia and 6 cwt. of sulphate of potash. The smaller produce of No. X. either arises from the presence of too large a quantity of soluble saline constituents in this mixture of fertilizing substances, or from an unfavourable action of sulphate of potash. The crop on this plot looked far less healthy than on No. XI. or on No. V.

In concluding this report of my experiments made in 1856, I may mention that I have watched the appearance of the crop on the experimental field succeeding the swedes. This field was sown with barley in 1857. The barley came up well and grew much more luxuriantly on the plots manured the year before with phosphate. Indeed, the difference in the appearance of the plots manured with phosphates and those plots unmanured or dressed with sulphate of ammonia and other salts, was so marked in spring, that the most inexperienced observer could single out with the greatest facility the spots upon which superphosphate was applied the year before. I stated my conviction that superphosphate is often used in much larger quantities than requisite for turnips, but it is consoling to know that a superphosphate, which, like the one employed in my experiments upon turnips, contained nearly the whole of the phosphates in a soluble form, when once incorporated with the soil, remains there ready to benefit not only the crop for the immediate use of which it is used, but also the succeeding crop, especially if that crop is barley. My own observations on the effect upon the succeeding barley of an excess of superphosphate applied to swedes, fully confirm the elaborate and highly important experiments of Messrs. Lawes and Gilbert on the growth of barley.

Experiments on Turnips, made in 1857.

1. *Germination Experiments.*

Having observed in 1856 that the turnips manured with sulphate of ammonia came up much later than those dressed with superphosphate, and even than the unmanured plots, I was anxious to verify this result by some additional experiments with sulphate of ammonia. It is generally believed that superphosphate pushes on rapidly the young turnip plant, and as phosphates form a large proportion of the ash of all seeds, it was not unlikely that the effect of a dressing of superphosphate would hasten the germination of the turnip-seed. At the same time, I thought it desirable to submit to experimental proof some other fertilizing matters, with respect to their power of either hastening or retarding the germination of turnip-seed; for it is self-evident that

it would be extremely useful if by some means or other the germination of the seed could be hastened, and the rapid growth of the young turnip plant promoted. The idea of dressing seed with various fertilizing matters is not a new one. Several attempts of applying manure to the seed instead of to the land have been made, and the most preposterous advantages resulting from seed-manuring held out by certain men, whose interest it was to sell comparatively cheap fertilizing matters at an enormous profit. These attempts, as might have been expected, have proved complete failures. I allude to these attempts of manuring and steeping the seed, because I do not wish to be suspected of entertaining for a moment the idea, that the system of seed-manuring is based on rational principles. My sole object in engaging in the subjoined experiments, was to ascertain if, by any chemical means the germination of the turnip-seed could be promoted, and to collect additional evidence respecting the effect of ammoniacal manures on the germination of seeds.

With this object in view, I made the following experiments with new Norfolk-bell turnip-seed.

No.

1. 100 seeds were soaked for 20 hours in distilled water, containing 2 per cent. of sulphuric acid (SO_3, HO).
2. 100 seeds were soaked for 20 hours in distilled water, containing 1 per cent. of sulphuric acid (SO_3, HO).
3. 100 seeds were soaked for 20 hours in distilled water, containing 5 per cent. of sulphuric acid.
4. 100 seeds were soaked for 20 hours in distilled water, containing 2 per cent. of sulphate of ammonia.
5. 100 seeds were soaked for 20 hours in distilled water, containing 5 per cent. of sulphate of ammonia.
6. 100 seeds were soaked for 20 hours in 3 oz. of distilled water and ½ oz. bone-ash dissolved in sulphuric acid (the same of which an analysis is given above).
7. 100 seeds were soaked for 20 hours in 3 oz. of distilled water and 1 oz. of bone-ash, dissolved in sulphuric acid.
8. 100 seeds were soaked for 20 hours in 3 oz. of distilled water and ½ oz. of Peruvian guano.

The seed prepared in this way was sown on the 15th of May, 1857, in garden-mould in flowerpots. On the same day were sown also in flowerpots—

9. 100 seeds with ½ oz. of superphosphate, made by dissolving fine bone-dust in 50 per cent. of brown acid.
10. 100 seeds with ½ oz. of bone-ash, dissolved in acid (the same sample used in the other experiment).
11. 100 seeds with 1 oz. of bone-ash, dissolved in sulphuric acid.
12. 100 seeds with ½ oz. of Peruvian guano.
13. 100 seeds with ½ oz. of Peruvian guano, mixed with 1 oz. of soluble silica rock, finely powdered.
14. 100 seeds with ½ oz. of sulphate of ammonia, mixed with ½ oz. of powdered soluble silica rock.

15. 100 seeds, sown with 120 grs. of sulphate of ammonia and ½ oz. of powdered soluble silica rock.
16. 100 seeds with ¼ oz. of Peruvian guano.
17. 100 seeds without anything.
18. 100 seeds without anything.

The flowerpots containing these 18 experiments were regularly watered every day. The soil was constantly kept in a moderately moist condition, and the result observed from time to time.

On reference to my notes, taken at the time, I find the entries embodied in the following Tabular Statement. (See page 166.)

An inspection of these Tables will show amongst other particulars :—

1. That the seed employed in the experiments was of good quality, 94 in one trial and 90 in a second, out of 100, having germinated.

2. That turnip-seed unprepared and merely moistened occasionally, germinated more rapidly than the seed in all the other experiments.

3. That very dilute sulphuric acid killed the seed.

4. That a dilute solution of sulphate of ammonia killed many seeds, and retarded greatly the germination of those that survived. Thus two-thirds of the number of turnip-seeds were killed, and only one-third germinated. It will also be seen that sulphate of ammonia sown in considerable quantity with the seed also killed it, whilst in more moderate doses it greatly retarded the germination of the surviving seeds.

5. That Peruvian guano, even in small quantities, had the same effect as sulphate of ammonia : hence the danger of drilling in turnip-seed or carrots with guano, even when previously mixed with ashes.

6. That superphosphate of lime, instead of hastening, rather retarded the germination of turnip-seed.

7. That superphosphate made from bones and containing ammonia is more liable to injure the seed, than superphosphate made from bone-ash or mineral phosphates. Thus it will be seen, that only 60 plants came up in No. 9, in which bone superphosphate was used, and 80 plants in No. 10, in which experiment the same quantity of bone-ash superphosphate was employed.

It follows from these experiments—

1st. That it is advisable to mix artificial manures, such as guano and superphosphate, with as large a quantity of ashes as is practicable, if the manure is sown dry, and to mix the artificial manure with much water if the liquid manure drill is used. 2ndly. That superphosphate of lime, especially when made from

Table, *showing the Number of Plants come up from 100 Turnip Seeds at different Periods.*
The Seed was sown on the 15th of May, 1857.

		May 19.	May 21.	May 22.	May 23.	May 24.	May 26.	May 29.	June 1.	June 10
No. 1	100 seeds, soaked in water containing 2 per cent. of sulphuric acid	none	none	none	none	none	none	none	none	none
,, 2	100 seeds, soaked in water containing 1 per cent. of sulphuric acid	,,	,,	,,	,,	,,	,,	,,	,,	,,
,, 3	100 seeds, soaked in water containing 5 per cent. of sulphuric acid	,,	,,	,,	,,	,,	,,	,,	,,	,,
,, 4	100 seeds, soaked in water containing 2 per cent. of sulphate of ammonia	,,	4	10	11	19	24	30	33	33
,, 5	100 seeds, soaked in water containing 5 per cent. of sulphate of ammonia	,,	14	24	24	29	33	33	33	33
,, 6	100 seeds, soaked in 3 oz. of distilled water and ½ oz. of bone-ash superphosphate	,,	1	1	2	3	3	3	4	4
,, 7	100 seeds, soaked in 3 oz. of distilled water and 1 oz. of bone-ash superphosphate	,,	none	1	1	1	1	1	1	1
,, 8	100 seeds, soaked in 3 oz. of distilled water and ½ oz. Peruvian guano	,,	,,	1	4	15	17	19	19	19
,, 9	100 seeds, sown with ½ oz. of bone-superphosphate ..	,,	2	15	26	35	a great many not counted	as before	as before	60
,, 10	100 seeds, sown with ½ oz. of bone-ash superphosphate	,,	10	29	37	58				80
,, 11	100 seeds, sown with 1 oz. of bone-ash superphosphate	,,	none	none	1	4	10	14	18	19
,, 12	100 seeds, sown with ½ oz. of Peruvian guano	,,	,,	,,	none	none	none	none	none	none
,, 13	100 seeds, sown with ½ oz. of Peruvian guano, mixed with 1 oz. of soluble silica rock	,,	,,	,,	,,	,,	,,	,,	,,	,,
,, 14	100 seeds, sown with ¼ oz. of sulphate of ammonia, mixed with ½ oz. soluble silica rock	,,	,,	,,	,,	,,	,,	,,	,,	,,
,, 15	100 seeds, sown with 120 grs. of sulphate of ammonia, mixed with ½ oz. of powdered soluble silica rock.	,,	,,	,,	,,	,,	,,	,,	4	16
,, 16	100 seeds, sown with ¼ oz. of Peruvian guano	,,	,,	,,	,,	,,	,,	,,	none	20
,, 17	100 seeds, sown without anything	a good many seeds had germinated	seed well up	as before	as before	as before	as before	as before	as before	94
,, 18	100 seeds, sown without anything									90

from bones, does not hasten the germination of turnip-seed, but rather the contrary.

I would observe, however, that when fairly up the plants manured with superphosphate grew much more vigorously than the others, and soon were twice as big as the rest. Although superphosphate does not promote a more rapid germination of the seed, it is yet extremely useful in favouring a vigorous growth of the plant, thereby bringing the crop out of reach of the turnip fly.

2. *Field Experiments made in* 1857.

The negative results obtained in 1856 with sulphate of ammonia induced me to try this salt again, as well as gypsum and phosphates, and phosphates in conjunction with sulphate of ammonia, in another part of our farm. It occurred to me, that probably the unfavourable results with sulphate of ammonia might have been due to an excess of this powerful manuring substance having been employed in my experiments in 1856. It will be remembered that I applied sulphate of ammonia at the rate of 6 cwt. per acre, a quantity which, considering the inconsiderable depth of the experimental field, may be called excessive.

It is remarkable, however, that in conjunction with soluble phosphate, sulphate of ammonia proved equally inefficient, showing neither a beneficial nor the contrary effect. In order to study the effects of small quantities of ammoniacal salts on the turnip crop, I used only 1½ cwt. per acre in my experiments made in 1857. In conjunction with these more theoretical experiments, I instituted several others with fertilizers much recommended as turnip-manures. The field selected for the experimental trials with these manures was somewhat deeper, more level, and altogether rather better than the experimental field in 1856. A portion of the soil taken from a large sample, from different parts of the field, was submitted to analysis, and the following results obtained:—

Composition of Soil from Experimental Field, No. 19, *of the Royal Agricultural College Farm, Cirencester.*

Moisture (when analysed)	1·51
Organic matter and water of combination	11·08
Oxides of iron and alumina	14·25
Carbonate of lime	10·82
Sulphate of lime	·71
Magnesia	·51
Potash (soluble in acid solution)	·32
Soda ditto ditto	·05
Phosphoric acid	·10
Insoluble silicious matter (chiefly clay)	61·78
	101·13

A comparison of the composition of this soil with that of the experimental field in 1856, shows, that the chemical characters of both soils are very much alike. It will be seen that both contained sulphate of lime as gypsum in appreciable quantities, and I may mention, in passing, that this is the case with most soils in our neighbourhood. The presence of gypsum in these soils, no doubt, accounts for the fact, that gypsum is of no use whatever in our neighbourhood, and I believe, generally, on the calcareous soils resting on the oolite. In other districts, gypsum is said to be a very useful fertilizer, especially for leguminous crops, such as beans or peas, but though I have repeatedly tried its effects on these crops as well as upon roots, clover, and grass, I have never seen the slightest effect produced by it.

The proportion of phosphoric acid in this soil is appreciable; the figures stated in the above analysis express the average of two separate determinations which yielded respectively :—

1st determination of phosphoric acid	..	·106 per cent.
2nd ,, ,, ,,	..	·094 ,,
Mean	..	·100 per cent.

These determinations were made with great care by a comparatively speaking new process, known to professional analysts as the molybdate of ammonia process. It would be out of place to describe in this Journal the precautions that have to be observed in employing this process, but I may be allowed to observe, that I find no accurate results can be obtained, unless the yellow precipitate obtained by adding molybdate of ammonia to the acid solution of the soil, and consisting of molybdic and phosphoric acid, is redissolved in dilute ammonia, and the phosphoric acid determined as phosphate of magnesia. If properly executed, this process yields wonderfully accurate results, and certainly is one of the most beautiful analytical processes for determining, quantitatively, small proportions of phosphoric acid in soils, marls, and other minerals.

An acre of this land was measured out and divided into twenty parts. The land was ridged up; the different manures sown by hand, after having been carefully mixed with three times their weight of fine red ashes or burnt soil; and the seed drilled on the ridge on the 10th of June. The turnip-seed sown was that of white swedes. Each experimental plot occupied four rows of equal length. All the plots were sown on the same day, and treated afterwards in precisely the same manner.

The following list exhibits the arrangement of the experimental field, the kinds of manures employed, and their quantities, calculated per acre :—

Experiments upon White Swedes, in Field No. 19, *Royal Agricultural College Farm, Cirencester.*

PER ACRE.

To Plot	I. ..	3 cwt. of phospho-Peruvian Guano, No. 1.
,,	II. ..	3 ,, ,, ,, ,, ,, No. 2.
,,	III. ..	1½ ,, ,, ,, ,, ,, No. 1.
,,	IV. ..	3 ,, ,, ,, ,, ,, No. 3.
,,	V. ..	3 ,, ,, ,, ,, ,, No. 4.
,,	VI. ..	4 cwt. of Binn's patent manure.
,,	VII. ..	3 ,, of superphosphate.
,,	VIII. ..	3 ,, of fine bone-dust.
,,	IX. ..	3 cwt. of superphosphate, made by dissolving the same fine bone-dust used in No. VIII., in 50 per cent. of sulphuric acid.
,,	X. ..	3 cwts. of bone-superphosphate (purchased).
,,	XI. ..	Nothing.
,,	XII. ..	3 cwt. of home-made superphosphate, made from coprolites and fine bone-dust.
,,	XIII. ..	1½ cwt. of sulphate of ammonia.
,,	XIV. ..	1½ cwt. of sulphate of ammonia, and 1½ cwt. of bone-ash, dissolved in sulphuric acid.
,,	XV. ..	1½ cwt. of bone-ash, dissolved in sulphuric acid, without ammonia.
,,	XVI. ..	4 cwt. of gypsum.
,,	XVII. ..	4 cwt. of wool-manure for turnips.
,,	XVIII. ..	9 cwt. of red ashes alone (the same quantity of ashes was used with the manures in the other experiments).
,,	XIX. ..	4 cwt. of poudrette de Bondy (Paris nightsoil manure).
,,	XX. ..	3 cwt. of Peruvian guano.

On each plot a good plant was obtained, and the crop singled on the 16th of July, with the exception of the plots upon which sulphate of ammonia and Peruvian guano were employed. The plants here were not far enough advanced to be singled. We have here presented to us another instance, which shows that ammoniacal manures, even when used in moderate quantities, retard the growth of turnips in their first period of existence. Special care, I may mention, was taken in these experiments thoroughly to mix the ammoniacal and other manures with ashes, and to prevent the seed from coming into direct contact with the artificial manures.

The appearance of the crop was observed from time to time, and the turnips of each plot taken up on the 19th of November: after trimming and cleaning, the whole produce of each plot was carefully weighed.

The result of these weighings is embodied in the following Table, which also contains the increase of each plot over the unmanured portions.

TABLE, *showing Produce in Swedes, topped and tailed, and cleaned, per Acre, and Increase per Acre, on Field No.* 19, *College Farm.*

Plot		Produce per Acre. tons.	cwt.	qrs.	lbs.	Increase per Acre. tons.	cwt.	qrs.	lbs.
I.	3 cwt. phospho-Peruvian guano, No. 1.	9	6	2	18	2	14	3	22
II.	3 cwt. ,, ,, ,, No. 2.	8	9	2	2	1	17	3	6
III.	1½ cwt. ,, ,, ,, No. 1.	8	19	0	5	2	7	1	9
IV.	3 cwt. ,, ,, ,, No. 3.	10	3	0	5	3	11	1	9
V.	3 cwt. ,, ,, ,, No. 4.	10	5	2	24	3	14	0	0
VI.	4 cwt. Binn's patent manure	8	14	2	18	2	2	3	22
VII.	3 cwt. of superphosphate of lime	10	17	0	16	4	5	1	20
VIII.	3 cwt. of fine bone-dust	8	11	0	26	1	19	2	2
IX.	3 cwt. of fine bone-dust, dissolved in acid	9	14	3	1	3	3	0	5
X.	3 cwt. of bone superphosphate, purchased	9	17	2	2	3	5	3	6
XI.	Nothing	6	11	2	24		..	..	
XII.	3 cwt. of home-made superphosphate ..	10	12	0	21	4	0	1	25
							Decrease.		
XIII.	1½ cwt. of sulphate of ammonia	5	6	0	21	1	5	2	3
							Increase.		
XIV.	1½ cwt. of sulphate of ammonia, and 1½ cwt. of dissolved bone-ash	9	3	0	26	2	11	2	2
XV.	1½ cwt. dissolved bone-ash	8	18	3	22	2	7	0	26
XVI.	4 cwt. of gypsum	6	13	3	17	0	2	0	21
XVII.	4 cwt. of wool-manure	8	16	3	22	2	5	0	26
XVIII.	9 cwt. of red ashes alone	6	16	3	1	0	5	0	5
XIX.	4 cwt. of Poudrette de Bondy	8	14	1	25	2	2	3	1
XX.	3 cwt. of Peruvian guano	8	18	1	25	2	6	3	1

All the manures employed in the experiments were carefully analysed. In commenting upon the results obtained in the field, I shall give the analysis of the artificial manures, and accompany them with some general remarks, which I trust will be found useful to those readers who are in the habit of buying artificials for their root crops. I would also make the remark that in all accounts of manuring experiments it is absolutely necessary to convey to the reader some idea of the character of the manures employed in the experiments; and this can only be done by giving an analysis of the different fertilizers. I have no hesitation in saying that accounts of experiments, in which analyses of the manures experimented with are omitted, are much better suppressed than published, for such experiments are more calculated to do harm than good. This remark of course does not apply to fertilizers of a definite chemical composition, or to fertilizers like Peruvian guano, the average composition of which is well known. What is the use, I would ask, of recording experiments with superphosphate, when it is well understood that superphosphate can be prepared in twenty different ways and of a strength which may make it worth 2*l.* or 10*l.* a ton? Again, I would ask, what is the use of comparing the effects

of superphosphate with nitro-phosphate without stating the composition of both, since nitro-phosphate is only a commercial name occasionally given to manures, which are essentially superphosphates? I have seen published accounts of experiments with superphosphate, blood-manure, nitro-phosphate, and ammonia-phosphate, and with mixtures of these manures; but had the author of those experiments known that blood-manure is but a name that applies to artificial manures which in nine cases out of ten are in reality superphosphates, and that nitrophosphate and ammonia-phosphate often hardly contain any nitrogen or ammonia, but are nothing more or less than superphosphate, he would have modified his experiments, or at any rate given the reader some clue as to the character of the manures with which he experimented.

Plot I.—Manured with phospho-Peruvian guano, No. 1, at the rate of 3 cwt. per acre.

Produce	9 tons 6 cwt. 2 qrs. 18 lbs.
Increase per acre ..	2 tons 14 cwt. 3 qrs. 22 lbs.

The swedes looked remarkably healthy until the beginning of September, when they were attacked by mildew and made but slow progress.

Composition of Phospho-Peruvian Guano, No. 1.

Moisture		11·84
* Organic matter and ammoniacal salts		10·35
Bi-phosphate of lime		11·88
Equal to bone-earth, rendered soluble by acid		(18·54)
Insoluble phosphates		29·32
containing: Phosphoric acid	13·51	..
containing: Lime	15·81	..
Hydrated sulphate of lime		25·47
Alkaline salts, containing ·21 phosphoric acid		4·77
Magnesia		·86
Insoluble silicious matter (sand)		5·51
		100·00

* Containing nitrogen	2·09
Equal to ammonia	2·34
Percentage of phosphates. rendered soluble by acid	18·54
,, of insoluble phosphates, calculated as bone-earth	34·25
Total phosphates, calculated as bone-earth ..	52·79

It will be seen that this and the other samples of phospho-Peruvian guano are very valuable manures that are distinguished from other fertilizers by a high percentage of phosphates, a large proportion of which is rendered soluble by treatment with sulphuric acid.

The insoluble phosphates in this guano are composed for the greater part of two equivalents of lime and one equivalent of

phosphoric, instead of three equivalents of lime and one equivalent of phosphoric acid as in the ordinary bone-phosphate. Originally this guano does not contain any appreciable amount of soluble phosphate, but chiefly consists of bi-basic phosphate of lime, and as this phosphate requires only one equivalent of sulphuric acid to be rendered soluble or converted into bi-phosphate of lime, whereas the ordinary bone-phosphate requires two equivalents of sulphuric acid for this purpose, a valuable and highly concentrated manure can be prepared from it with less expenditure of sulphuric acid than is requisite in changing other phosphatic materials, such as bone-ash, coprolites, &c., into soluble phosphates. This circumstance fully accounts for the comparatively small quantity of sulphate of lime which this fertilizer contains.

Plot II.—Manured with phospho-Peruvian guano, No. 2, at the rate of 3 cwt. per acre.

Produce	8 tons 9 cwt. 2 qrs. 2 lbs.
Increase per acre ..	1 ton 17 cwt. 3 qrs. 6 lbs.

The tops of this plot were not quite so large as those in No. I. The plants grew very vigorously at first, but like all the other plots received a sudden check by the extremely warm and dry weather in August.

An analysis of the guano used in this experiment gave the following results:—

Composition of Phospho-Peruvian Guano, No. 2.

Moisture			15·42
* Organic matter and ammoniacal salts			3·85
Bi-phosphate of lime			15·22
Equal to bone-earth, rendered soluble by acid			(23·74)
Insoluble phosphates, consisting of: ..	Phosphoric acid ..	13·73	24·41
	Lime	10·68	
Hydrated sulphate of lime			32·13
Alkaline salts			1·87
Insoluble silicious matter			7·10
			100·00

* Containing nitrogen	·40
Equal to ammonia	·49
Percentage of phosphates, rendered soluble by acid	23·74
,, of insoluble phosphates, calculated as bone-earth (tribasic phosphates, 3 Ca O, + P O_5)	29·74
Total percentage of phosphates calculated as tribasic phosphates	53·48

In this sample of phospho-Peruvian guano the proportion of soluble phosphate is larger than in the preceding, and the total amount of phosphates in both is about the same. There is a

great difference in the amount of ammonia in this and the preceding guano.

Notwithstanding the larger percentage of soluble phosphate, the guano No. 2 has not given quite so good a result as No. 1, and it appears to me that this may have been due to the sudden check which the crop sustained, and which will be felt all the more, the more rapid the progress has been at first.

Plot III.—Manured with 1½ cwt. of phospho-Peruvian guano per acre.

Produce	8 tons 19 cwt. 5 lbs.
Increase per acre ..	2 tons 7 cwt. 1 qr. 9 lbs.

Half the quantity of the same guano used in Plot No. 1, it will be perceived, gave very nearly the same increase as the larger quantity, which is a convincing proof of the fact that the larger amount of phosphates in these manures has not had a fair chance of producing the effect which in more favourable seasons they would no doubt have produced.

Plot IV.—Manured with phospho-Peruvian guano, No. 3, at the rate of 3 cwt. per acre.

Produce ..	10 tons 3 cwt. 5 lbs.
Increase ..	3 tons 11 cwt. 1 qr. 9 lbs.

No difference in the appearance of this and the preceding plots. The composition of this guano was found as follows:—

Moisture			10·07
Organic matter and ammoniacal salts			16·97
Bi-phosphate of lime			9·89
Equal to bone-earth, rendered soluble by acid			(15·42)
Insoluble phosphates, consisting of: ..	Phosphoric acid ..	18·79	37·61
	Lime	18·82	
Hydrated sulphate of lime			16·98
Alkaline salts			3·13
Insoluble silicious matter			5·35
			100·00

Containing nitrogen	2·12
Equal to ammonia	2·57
Percentage of phosphates rendered soluble	15·42
„ of insoluble phosphates, calculated as tribasic phosphates of lime	40·71
Total phosphates	56·13

This guano resembles in composition the one used in Plot I., but contains less soluble and more insoluble phosphate.

Plot V.—Manured with phospho-Peruvian guano, No. 4, at the rate of 3 cwt. per acre.

Produce ..	10 tons 5 cwt. 2 qrs. 24 lbs.
Increase ..	3 tons 14 cwt.

Composition:

Moisture			13·06
* Organic matter and ammoniacal salts			3·65
Bi-phosphate of lime			11·75
Equal to bone-earth, rendered soluble by acid			(18·33)
Insoluble phosphates consisting of: ..	Phosphoric acid ..	21·61	39·33
	Lime	17·72	
Hydrated sulphate of lime			23·17
Alkaline salts			1·76
Insoluble silicious matter			7·28
			100·00

* Containing nitrogen	·32
Equal to ammonia	·38
Percentage of phosphates, rendered soluble	18·33
,, of insoluble phosphates, calculated as tribasic phosphate of lime	46·82
Total percentage of phosphates ..	65·15

The total percentage of phosphates in this guano is very large indeed; the amount of ammonia, on the other hand, is inconsiderable. Notwithstanding the small amount of ammonia, the sample marked No. 4 has given the best result of the four manures that bear the name of phospho-Peruvian guano.

All four are very concentrated manures, which, as mentioned already, in more favourable seasons would have given, I do not doubt, a much larger increase.

From the following experiments it will appear distinctly that the produce on the experimental field could not be raised by any description of manure much above ten tons per acre, nor can there be any doubt that a large proportion of the phosphates in these guanos, on account of the long-continued dry weather, remained in the soil inactive.

Plot VI.—Manured with Binn's patent manure at the rate of 4 cwt. per acre.

Produce ..	8 tons 14 cwt. 2 qrs. 18 lbs.
Increase ..	2 tons 2 cwt. 3 qrs. 22 lbs.

The turnips on this plot did not look quite so well as the five preceding lots, especially in the leaf and during the first three months.

On analysis Binn's patent manure gave the following results:—

Moisture	25·61
* Organic matter	20·15
Phosphates and oxides of iron and alumina ..	3·74
Sulphate of lime	1·67
Carbonate of lime	15·47
Chloride of sodium (common salt)	9·35
Insoluble silicious matter	23·61
Magnesia and loss	·40
	100·00

* Containing nitrogen	·845
Equal to ammonia	[illegible]

A comparison of the analysis of this patent article with that of genuine Peruvian guano will show at once the inferiority of Binn's manure, for it is poor in all the essential and expensive fertilizing matters. It contains no soluble phosphate whatever, and very little insoluble phosphate, nor is it rich in ammonia. On the other hand it abounds in sand and carbonate of lime—constituents which on a calcareous clay soil, like the one on which the experiments were tried, cannot possibly do any good.

It will be observed that Binn's manure contains likewise a considerable quantity of common salt, and I cannot help thinking that the salt in this otherwise all but valueless artificial manure has had a beneficial effect upon the crop. It is possible that salt added to superphosphate will prove as valuable to swedes as to mangolds, particularly in dry seasons like the last. I hope to be able at a future period to report the results of field experiments with salt as a manure for swedes. In the mean time I would recommend to the notice of agriculturists the following experiments, as likely to throw light on the use of salt as a manure for turnips :—

1.	3	cwt.	of superphosphate per acre.					
2.	3	,,	of same superphosphate and		$\frac{1}{2}$	cwt.	of salt per acre.
3.	3	,,	of	,,	,,	1	,,	of ,,
4.	3	,,	of	,,	,,	$1\frac{1}{2}$	,,	of ,,
5.	$1\frac{1}{2}$	,,	of salt alone per acre.					
6.	2	,,	of	,,	,,			

Salt, perhaps, may be found useful in preventing mildew in turnips.

Whether or not it was the salt in Binn's patent manure that produced almost as good a crop as 3 cwt. of Peruvian guano, we have here presented to us a striking example of an inferior manure giving as good a result as the best artificials. This shows plainly how little dependence can be placed upon a single field experiment, and how fallacious it is as a test, so called practical, for arriving at anything like a fair conclusion as to the value of artificial manures.

In dry and unfavourable seasons, the very best manures are much more likely to do harm than poor or indifferent fertilizers. The reason of this is obvious. A manure, such as a concentrated superphosphate, rapidly pushes on the plant, and when there is abundance of moisture the process of assimilation goes on without interruption; but when dry weather sets in and continues for a long time, the vigorously growing plant receives a sudden check, from which it has difficulty in recovering, whilst plants scantily supplied with the more energetic fertilizing substances are far less liable to suffer under these circumstances.

Plot VII.—Manured with superphosphate at the rate of 3 cwt. per acre.

Produce	..	10 tons 17 cwt. 16 lbs.
Increase	..	4 tons 5 cwt. 1 qr. 20 lbs.

From first to last this experimental plot had the lead as to appearance, and the result of the weighings showed that it yielded in reality the best crop.

The superphosphate used in this experiment had the following composition:—

Moisture	10·80
* Organic matter	4·21
Biphosphate of lime	20·28
Equal to bone-earth, rendered soluble by acid	(31·63)
Insoluble phosphates	4·11
Hydrated sulphate of lime (gypsum)	46·63
Alkaline salts (common salt)	10·78
Insoluble silicious matter (sand)	3·19
	100·00

* Containing nitrogen	·34
Equal to ammonia	·41

I need hardly say that this is an excellent superphosphate, which, at 7*l.* 10*s.*, the price at which it was sold, is an exceedingly cheap manure. The price of all raw materials employed in the manufacture of artificial manures having gone up very much since the beginning of this season, I hardly think it possible that the maker of this superphosphate can supply his customers this season with an article quite so rich in soluble phosphate at 7*l.* 10*s.* per cwt. But should the proportion of bone-earth rendered soluble by acid be only 22 or 23 per cent., and the manure be prepared equally dry and fine as hitherto, I have no hesitation in saying, that such a superphosphate at 7*l.* 10*s.* will be 2*l.* or 3*l.* cheaper than most samples which I analysed during this season.

It is worthy of notice, that this superphosphate contained very little ammonia, but an appreciable quantity of salt, which I have no doubt added to its efficacy; for I find that other superphosphates, rich in soluble phosphates, and containing a considerable proportion of ammonia, but no salt, had not near so good an effect upon the turnip-crop in 1857.

Plot VIII.—Manured with 3 cwts. of fine bone-dust per acre:—

Produce	..	8 tons 11 cwt. 26 lbs.
Increase	..	1 ton 19 cwt. 2 qrs. 2 lbs.

This bone-dust was extremely well pounded, being as fine as the finest sawdust.

On analysis it yielded in 100 parts:

Moisture	6·86
* Organic matter	13·14
Phosphates of lime and magnesia (bone-earth)	68·17
Carbonate of lime	6.79
Alkaline salts	1·90
Insoluble silicious matter (sand)	3·42
	100·00

* Containing nitrogen	1·83
Equal to ammonia	2·22

Although sold as the finest bone-dust, this article was, in reality, a mixture of about equal parts of fine bone-dust and commercial powdered bone-ash. The proof of this is furnished in the above analysis; and as bone-ash can be bought at a cheaper rate than fine bone-dust, it is not fair to offer for sale a mixture of 50 per cent. of fine bone-dust and 50 per cent. of bone-ash under the name of genuine bone-dust.

I may mention, in passing, that I analysed another sample of fine bone-dust, bought from the same maker, but earlier in the season, probably at a time when there was less demand for fine dust than later, when the deficiency in the supply evidently was made up by a larger proportion of bone-ash.

This sample consisted of about two-thirds of fine bone-dust and one-third of bone-ash, as will be seen by inspecting the following results, which it yielded on analysis:—

Water	9·11
* Organic matter	21·25
Phosphates of lime and magnesia (bone-earth)	61·94
Carbonate of lime	5·89
Alkaline salts	1·70
Insoluble silicious matter (sand)	1·32
	100·00

* Containing nitrogen	2·84
Equal to ammonia	3·45

Plot IX.—Manured with 3 cwt. of superphosphate, made by dissolving fine bone-dust used in previous experiments in 50 per cent. of oil of vitriol:—

Produce	9 tons 14 cwt. 3 qrs. 10 lbs.
Increase	3 tons 19 cwt. 2 qrs. 2 lbs.

On comparing the produce of Plot IX. with Plot VIII., the advantage of dissolving bone-dust in acid will appear at once.

When analysed this superphosphate gave the following results:—

Water	24·33
* Organic matter and ammoniacal salts	5·04
Bi-phosphate of lime	17·00
Equal to bone-earth, rendered soluble by acid ..	(26·52)
Insoluble phosphates	9·89
Hydrated sulphate of lime	39·25
Alkaline salts and magnesia	2·81
Insoluble silicious matter (sand)	1·68
	100·00
* Containing nitrogen	1·28
Equal to ammonia	1·55

Plot X.—Manured with 3 cwt. of bone-superphosphate:—

Produce .. 9 tons 17 cwt. 2 qrs. 2 lbs.
Increase .. 3 tons 5 cwt. 3 qrs. 6 lbs.

The superphosphate used in this experiment was bought, and had been prepared from coarse bone-dust, and differed materially in composition from the preceding superphosphate, which I specially prepared for experimental purposes.

It will be seen by the subjoined analytical results, that the superphosphate used upon Plot X. contained very little soluble phosphate, but a large proportion of insoluble phosphate and much ammonia.

Notwithstanding the deficiency of soluble phosphate, it gave quite as good a produce as the preceding superphosphate, which was much richer in soluble phosphate.

The following are the results obtained on analysing this superphosphate:—

Water	13·79
* Organic matter and ammoniacal salts	15·00
Bi-phosphate of lime	2·84
Equal to bone-earth, rendered soluble	(4·43)
Insoluble phosphates	25·54
Hydrated sulphate of lime	21·75
Anhydrous sulphate of lime	4·58
Alkaline salts and magnesia	4·36
Insoluble silicious matter (sand)	12·14
	100·00
* Containing nitrogen	2·45
Equal to ammonia	2·91

Plot XI.	Nothing	Produce,	6 tons	11 cwt.	2 qrs.	24 lbs.
,, XVI.	4 cwt. of gypsum ..	,,	6 ,,	13 ,,	3 ,,	22 ,,
,, XVIII.	(9 cwt. of red ashes)	,,	6 ,,	16 ,,	3 ,,	1 ,,

The produce of these three plots is so much alike, that the small differences may be safely ascribed to natural variations of the soil; at the same time, the produce of Plots XI., XVI., and XVIII., shows that the field on which the experiments were tried

was uniform in its character, and also that gypsum had no effect whatever on the turnip-crop.

Plot XII.—Manured with 3 cwt. of home-made superphosphate:—

Produce	..	10 tons 12 cwt. 21 lbs.
Increase	..	4 tons 1 cwt. 25 lbs.

The superphosphate used in this experiment was made on our farm from coprolites, fine bone-dust, sulphuric acid, and salt. It yielded on analysis—

Water	22·83
* Organic matter	4·88
Bi-phosphate of lime	8·28
Equal to bone-earth, rendered soluble by acid ..	(12·91)
Insoluble phosphates	16·21
Hydrated sulphate of lime	37·42
Alkaline salts (common salt)	5·53
Insoluble silicious matter (sand)	4·85
	100·00

* Containing nitrogen	·55
Equal to ammonia	·66

It will be observed, that this superphosphate contains little ammonia, and about 5½ per cent. of salt besides soluble and insoluble phosphate. In its effect upon the crop it was nearly equal to the superphosphate used in Plot VII., which is a far superior and more expensive fertilizer.

Again, it will be observed, that it produced a better result than the superphosphate made by dissolving fine dust in sulphuric acid, and costing at least 30*s.* more per ton.

Plot XIII.—Manured with 1½ cwt. of sulphate of ammonia:—

Produce	..	5 tons 6 cwt. 21 lbs.
Decrease	..	1 ton 5 cwt. 2 qrs. 3 lbs.

The sulphate of ammonia used in this experiment was found to consist in 100 parts of:—

Pure sulphate of ammonia ..	98·28
Fixed salts	·78
Moisture	·94
	100·00

The roots on this plot came up much later, and throughout the whole experimental period were in a backward condition, when compared with the rest of the field.

The plants looked decidedly worse than those on the unmanured portion. I mention, especially, that the swedes, contrary to what I expected, had a less luxuriant foliage than even on the unmanured plot.

Under the circumstances in which the sulphate of ammonia was tried in 1857, it had a decidedly injurious effect upon the yield of the turnip crop, although only 1½ cwt. of sulphate of ammonia had been employed per acre.

Plot XIV.—Manured with 1½ cwt. of sulphate of ammonia, and 1½ cwt. of dissolved bone-ash:—

Produce	..	9 tons 3 cwt. 26 lbs.
Increase	..	2 tons 11 cwt. 2 qrs. 2 lbs.

Plot XV.—Manured with 1½ cwt. of dissolved bone-ash:—

Produce	..	8 tons 18 cwt. 3 qrs. 22 lbs.
Increase	..	2 tons 7 cwt. 26 lbs.

The dissolved bone-ash used in these experiments was found to contain in 100 parts:—

Water	32·80
Organic matter	·13
Bi-phosphate of lime	18·49
Equal to bone-earth, rendered soluble by acid	(28·80)
Insoluble phosphates	6·43
Hydrated sulphate of lime	38·39
Alkaline salts	1·94
Sand	1·82
	100·00

The produce of these two plots may be considered as identical, and, as the superphosphate made from bone-ash contained no nitrogen or ammonia at all, we have here a positive proof of the inefficacy of ammonia on the soil of the experimental field in 1857.

Plot XVII. — Manured with 4 cwt. of wool manure for turnips:—

Produce	..	8 tons 16 cwt. 3 qrs. 22 lbs.
Increase	..	2 tons 5 cwt. 26 lbs.

The composition of this manure was found to be as follows:—

Moisture	21·26
* { Ammoniacal salts and soluble organic matter	10·52
* { Insoluble organic matter	5·28
Bi-phosphate of lime	1·41
Equal to bone-earth, rendered soluble by acid	(2·21)
Insoluble phosphates	12·63
Hydrated sulphate of lime	23·41
Alkaline salts (chiefly common salt	15·26
Insoluble silicious matter (sand)	10·23
	100·00

* Containing nitrogen	2·96
Equal to ammonia	3·63

Plot XIX.—Manured with 4 cwt. of Poudrette de Bondy, or dried night-soil from Paris :—

Produce ..	8 tons 14 cwt. 1 qr. 25 lbs.
Increase ..	2 tons 2 cwt. 3 qrs. 1 lb.

A sample of this manure, on analysis, yielded the following results :—

Water	25·20
* Organic matter	26·14
Phosphates	17·17
Sulphate of lime	4·21
Carbonate of lime	3·09
Alkaline salts	3·22
Magnesia	1·78
Insoluble silicious matter (sand)	18·61
	99·42

* Containing nitrogen	3·35
Equal to ammonia	4·07

It will be seen, that the Paris night-soil manure contains a good deal of phosphates, as well as nitrogenized matters. It is far superior to any description of night-soil manufactured in this country.

In its practical effects upon the turnip-crop in these experiments, it proved equal to wool-manure and Peruvian guano, but it does not follow from this, that its commercial value is equal to that of Peruvian guano.

Plot XX.—Manured with 3 cwt. of Peruvian guano :—

Produce ..	8 tons 18 cwt. 1 qr. 25 lbs.
Increase ..	2 tons 6 cwt. 3 qrs. 1 lb.

Composition :

Moisture	18·50
† Organic matter and ammoniacal salts	52·33
Phosphate of lime and magnesia	21·66
* Alkaline salts	6·41
Insoluble silicious matter	1·10
	100·00

* Containing phosphoric acid	1·46
† Containing nitrogen	14·16
Equal to ammonia	17·19

The analysis shows that the guano used in the experiment was genuine Peruvian guano of superior quality.

The turnips on this plot were for a long time decidedly inferior to the superphosphate turnips. But towards the middle of September the plants took a start, and the crop in Plot XX. then appeared the best in the field, so far as the tops were considered. Shortly before the time when the turnips were

taken up, the guano turnips were at least 3 inches higher in tops, and promised, so far as appearance went, the heaviest crop; but the weighing showed that the yield in bulbs was smaller than that of the plots manured with superphosphate free from nitrogen.

It appears in these experiments:—

1. That ammoniacal salts like sulphate of ammonia, used alone, had a decidedly injurious effect upon the turnip-crops, even when used in small quantities.

2. That ammoniacal manures applied to the turnips in the experimental field, kept back at first the turnip-crop, and had no beneficial effect either alone or in conjunction with phosphates.

3. That guano proved a less economical manure than superphosphate.

4. That the addition of salt to superphosphate is likely to be attended with beneficial results when used for turnips.

5. That, in dry seasons, the best artificial manures often produce hardly any greater effect upon roots, and may produce even less, than inferior and all but worthless manure.

6. That the value of an artificial manure, and its special effect upon different crops, cannot be determined by a single field-experiment.

In conclusion, I would observe that I intend continuing similar experiments on swedes for a number of years, and hope, on a future occasion, to present to the Society another Report on this subject.

AUGUSTUS VOELCKER.

Royal Agricultural College, Cirencester,
June, 1858.

VIII.—*Notes on the Wealden Clay of Sussex and on its Cultivation.* By SIDAY HAWES.

THE Weald, from Wald, a wood—the whole tract having once been one great forest—is a fresh-water formation, comprising three divisions, namely, the Wealden clay, the Hastings sand, and the Purbeck beds. It is with the first of these only that the subject of these notes is connected.

The Wealden clay is essentially a wheat soil, and produces handsome crops of it, healthy and strong, with bright straw, and grain of a quality very superior to that grown on light lands; nor, where the land is fairly dealt with, is there any deficiency in quantity.

But though no one questions the wheat-bearing qualities of

the clay, it has been, unfortunately, too much taken for granted that it is impossible to grow root-crops in the stiff clays of the Weald. This, however, is a mistake, and I am satisfied that turnips, both swedish and common, if sown on land in good condition—that is, clean, fine, and full of manure—produce a good weight per acre, and are superior in quality to those grown on light land, though I admit that it is not so easy to get a plant of them. To secure this, early sowing is the best method; and though by drilling turnip-seed as early as May you may suffer from mildew, a mildewed crop is far better than none, and even this disease may be checked in a considerable degree by repeated horse-hoeing.

In growing root-crops of any kind on clay, success depends greatly on the previous management of the land.* Let it be ploughed as early as possible—that is, as soon as harvest is over and the field cleared—if you have men and horses to do it. This is good husbandry on any soil, but on clay it is absolutely necessary. Sometimes the shelled corn, which should fall to the share of the pigs, may be sacrificed, but this loss is insignificant compared with the loss caused by not ploughing early enough.

If the land be foul, it may be ploughed and cleaned in September, and ridged up in one-bout ridges as soon as possible—at all events, by the end of November. In these ridges the greatest surface will be exposed to the sun, wind, rain, and frost, the repeated action of which will break down the stiffest clay to a fine mould, such as no amount of harrowing and rolling can produce. This exposure is useful on undrained lands, but on those that are drained it is more so; and draining is, or ought to be, the first step towards growing beet and turnips.

Suppose, then, the land intended for root-crops to have been ridged up in autumn; let those ridges be split in February or early in March, and then left a few days or weeks, till the manure can be put in between them by once more splitting. Pass a light roller over the ridges, and drill in the seed; in this case a light roller may form a part of the drill. Whether the land be manured from the cattle-yard, or with guano and superphosphate of lime, it can hardly be over-manured. There are cases in which yard-manure may be advantageously applied in the autumn.

Beet, though perhaps it may not grow so large as it does on some mixed soils, likes the clay, and is of excellent quality when

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* Arthur Young, in his 'Agriculture of Suffolk,' published in 1813, speaks of autumn culture as excellent on stiff lands, and as being commonly practised in getting the land ready for a corn crop, so as to sow it on a stale furrow, and avoid spring ploughing. It is still more necessary in preparing for a crop of beet or swedes.

grown on it. The yellow globe and the long yellow seem to do better than the long red, but of this I am not certain. It flourishes on newly-cleared lands that have been well manured much more than turnips do, bearing the hot, dry weather, and even thriving in it, and it is an excellent first crop to be followed by wheat. Like wheat, it is a deep-rooted plant, which never grows so well as when the soil contains a large proportion of clay.

The climate of the Weald is warm, but the soil is cold, and it is best to lose no chance of putting in the seed in good order. The safest rule is to *sow when you can.* In some seasons this may be as early as the beginning of April, and the whole crop ought to be in the ground by the middle of May. The land being all manured with the last ploughing, it may be either drilled or dibbled, but it requires great care if the latter method be used, as beet seed will not grow if buried more than half an inch deep. A neighbour of mine grew an excellent crop of beet last year by sowing the seed in the following manner. Having mixed, in about the proportion of 1 bushel of wood-ashes, 1 cwt. of superphosphate, and 4 lbs. of seed, for an acre, a man with a hoe, having a blade of not more than 2 inches wide and about the same depth, and a handle 18 inches in length, made a small hole on the ridge, and dropped in about a dessert-spoonful of the mixture, which he carried in a bag hung round his neck. The handle of the hoe serves as a measure of the distance between hole and hole, and, as soon as the sower has dropped the mixture with his left hand, he covers it with a little earth by means of the hoe.

About 5 lbs. of beet-seed may be drilled or dibbled on one-bout ridges, from 27 to 30 inches apart. A cold, dry spring may keep the seed from vegetating for even 5 or 6 weeks, or it may show itself above-ground in a fortnight. The plants are very small at first and grow slowly, but increase immensely during the latter months of their growth; so that what appears at first a very thin plant may, in the end, prove to be a heavy crop. If, however, it fail in places, it is a good plan to dibble in swedish turnip-seed in the vacancies any time during May.

In May, also, the principal crop of swedish turnips may be drilled on ridge-work similar to that above mentioned for beet. This will allow the repeated use of the horsehoe, which is of the greatest service to all root-crops, and is equivalent to a summer's fallow for wheat. Thus the horse-hoeing answers a double purpose, and the root-crop, in many ways, becomes, as it does elsewhere, the mother of all other crops; for, to grow root-crops successfully, any kind of land must be kept both in high condition and clean at the same time, and these are essential points to be observed in farming on all soils.

A winter's fallow is indispensable for root-crops, and excellent also for oats, which will produce 6 or 8 bushels more per acre on a stale furrow than on land ploughed in February or March.

In a fine dry autumn, turnips may be fed off to great advantage with sheep, but such autumns do not often occur; when they do, a portion of the turnips may be thrown on grass-lands for sheep or cattle; but they will be all the better for being cut.

If turnips or swedes be sown early, they will be fit for use early in the autumn, *but no opportunity of getting them off the land must be neglected*, and the same may be said as to harvesting beet.

In no part of England is the want of keep after Christmas for cattle, sheep, and pigs, more felt than in the Weald. At this time beet comes in and fills up the void admirably. Through the trying months of March, April, and May it is in perfection. It is both better and cheaper than rye, and, acre for acre, it will keep more stock than any grass on this stiff soil. If the farmer have abundance of it, he will find it excellent for all stock, even in June and July, when fatting cattle in boxes may be kept on it with great advantage. Beet will not bear frost, either in the ground or out of it, but keeps perfectly well when packed close in long clamps covered with straw and then with earth. In these clamps it will ripen till it is wanted after Christmas. Swedes may be thrown in heaps of any size, and covered in the same manner, though they bear frost much better than beet.

Potatoes, though they do not yield heavy crops, are of good quality. The Jerusalem artichoke grows well on the clay, with a fair portion of manure, and is good for all stock during winter and spring, if it can be taken up and carted, without poaching the land too much. Whilst it remains in the ground no frost, however severe, will hurt it; in fact, it bears the intense cold of a North American winter without injury, but it will not keep out of the ground, for the tubers become shrivelled and worthless in a short time after they are dug. The tops yield a good deal of food, of which both horses and cattle are very fond. I have cut it late in the summer for this purpose, but have grown it only on a small scale, and in little odd corners of land which would not otherwise have been used at all. The long-continued wet autumn and winter of 1852-1853 was very injurious to my crop, a great part of which rotted in the ground; but, as the plants were grown on recently-cleared and undrained land, the chances were very much against them.

Beans are not much grown in the Weald; they are generally a poor crop, though now and then a fair crop of winter beans is

to be seen. Peas are grown, but to no great extent, and, as in other places, they are a very uncertain crop.

Excellent crops of clover are grown in the Weald, but, as in other parts of England, the land has in many instances become sick of clover, though no man has yet been able either to account for this sickness or to cure it. No kind or quantity of manure has afforded any remedy: after an interval of eight or more years, however, the land will have regained its clover-bearing qualities, and a crop will be certain. Clover is, of course, followed by wheat; and, as the clover too often fails, rye and other grasses mixed, under the name of *bents*, are sown, though it is one of the worst preparatory crops for wheat, especially when the grass is allowed to form its seed and thus rob the land as much as a crop of corn would do.

Very good crops of winter tares are grown on the clay, which, if they be fed off or the land be manured, may be advantageously followed by wheat. Sometimes the tares stand for seed, and then wheat is taken, which is very bad management, and I have known a heavy crop of tares ploughed in when in blossom to serve as manure for the succeeding wheat-crop.

Oats are frequently grown on a wheat-stubble; they are light in quality, and not very productive as to quantity. The Tartarian or one-sided oat is the kind generally grown; they are sown late, commonly as late as the end of March. Barley is not much grown, though in some cases it yields pretty well; it never makes a handsome sample.

The Weald clay, when limed, manured, and sown with grass-seeds adapted to the soil, makes pretty good pasture, and, if well underdrained, is more fattening than might be supposed; but it ought to be fed as much and mown as seldom as possible, for no land that I am acquainted with bears the scythe worse.

Of the Wealden Clay.

The thickness of the Wealden clay varies from 140 to 280 feet; it sometimes includes beds of sand and limestone; it is of various colours, generally yellow, but sometimes blue and brown, and is more or less stiff and tenacious in quality. William Smith, the "father of geology," called it the Oak-tree clay. Though it varies considerably in some particulars, it is all exceedingly sticky when wet, and, if ploughed in that state, turns up in large masses, which as they dry become hard as rock. If possible, land of this description should be ploughed only when in a dry state, for no harrowing or rolling will reduce these clay blocks to a fine mould, though every summer shower in succession will in some degree pulverize them; but if it be

ploughed early in one-bout ridges, and left exposed to the frosts of winter, the stiffest and closest clay will be reduced to as fine a mould as can be seen on a light-land farm, and this fine mould may be preserved through the summer by the frequent use of the horse-hoe. But this kind of land should never be ploughed or carted over when wet, nor should it be trodden by man or beast, whenever it is possible to avoid it. However, a sharp frost or a summer's fallow will set all right again.

If left undisturbed till they become dry again, no quantity of rain hurts these lands, *provided they are well underdrained.* On the contrary, every shower carries down into the earth some fertilizing matter which the clay detains, while the filtered water passes off through the drains. For the knowledge of this most valuable retentive property of clay we are indebted to Mr. Thompson, of Kirby Hall, near York. Indeed, it would seem that stiff clay not only filters but decomposes manure water, but whether by mechanical action or by chemical combination appears uncertain. It is probable also that the clay subsoil may be washed and purified from some injurious mineral matter by the rain-water as it passes through it, and is carried off by under-drains. That such hurtful properties do exist in the yellow subsoil, every man farming such land must have observed. The yellow clay that is thrown out in making a new drain is singularly infertile; yet, if after the land was drained, some of it were from time to time brought to the surface and exposed to the changes of the seasons, the value of the land would be greatly increased. "I have never yet seen clay thoroughly drained, deeply cultivated, and reasonably well farmed, which did not speedily lose the name of *hungry*, and earn the title of *grateful, clay.*" (See Royal Agricultural Society's Journal, vol. xvi. p. 368, note). These words may be applied with perfect truth to this district.

Subsoiling, which on some land has been found so beneficial, appears on the clay to have no good effect whatever. After subsoiling several acres in different years, by way of experiment, with 6 horses, I came to the conclusion that it was so much labour thrown away.

Though large districts of the Weald consist mainly of clay, yet the soil varies somewhat on every farm. In many fields it is observed to be stiffest on the higher ground, and to be lighter, or to have more sand naturally mixed with it, as it slopes down to a lower level. The subsoil varies from a stiff yellow clay to what is called shrave,* which consists of innumerable fragments of flaky pieces of mixed clay and sand, varying in size from 2

* Perhaps another word for shale, which, though a provincialism, is used by geologists to denote an indurated slaty clay which splits easily into thin flakes.

or 3 feet square to morsels not so thick as a nutshell. On some farms, under the clay may be found sand; on some, a brittle limestone full of fossil shells, and called Sussex marble; and on others a hard, heavy, blue limestone is found.

The best land is that which has clay for its subsoil: it is more retentive of moisture and of manure than the others, the wheat grown on it is good in quality and quantity, and it is observed to be much less liable to mildew than that which is grown on lands of which the subsoil is shravy.

Draining is the cheapest and most durable of all improvements, and nothing can be done without it towards making clay lands grow all that they are capable of growing; but though most of the Weald lands have a good fall for draining, and all have abundance of clay for making pipes, and fuel enough to burn them, yet draining goes on but slowly. The recent invention of making draining-pipes of all sizes by machinery is of immense value here. Formerly, draining could only be done on a small scale on account of the expense, but now the practice is more frequent.

In burning either bricks, tiles, or pipes, some very stiff clay shrinks too much in the kiln; bricks will come out too small every way, and draining-pipes made with a 2-inch die will measure only 1½ inch after burning. But a great deal of very superior brick earth, which hardly shrinks at all in the fire, is found in various parts of the Weald. With a home-made machine, and a kiln made merely of clay, as described by Mr. Hodges in the Royal Agricultural Society's Journal, I made draining-pipes of 1½ inch after burning. My drains are 30 inches deep and 1 rod apart, and, without offering any opinion as to what might be required on other soils, I am quite satisfied that here this depth answers perfectly well; for in the Wealden clay there are, properly speaking, no land-springs, so that all that has to be carried off is the surface-water. Some 4 or 5 acres, which I drained at the depth of 4 feet, have shown no superiority over the rest of the land which was drained at 30 inches; but the expense is almost double, as the labour of digging deep drains in stiff clay is immense. On what is called *shravy* land, perhaps, there may be some necessity for making deeper drains, but *in all cases wide intervals between them should be avoided.* The drains should slope as the land slopes, and the ploughing should be across the slope, so that the rain may not be carried off immediately by the furrows, but be detained till it finds its way to the drains, which it will do through the closest subsoil. But rain falling on undrained lands, and carried off by surface-drains only, takes with it much fine mould and soluble matter into low grounds where they are not wanted; and where no surface-drains are

made, the stagnant water injures or destroys every crop, and chills the best land by evaporation in the spring. No amount of manure will counterbalance the evil effects of stagnant water going off by evaporation.

Whether under crop or in pasture, these clays are strongly acted on by heat and drought. In a dry summer and autumn they are cracked in every direction, the fissures being from 1 to 4 or 5 feet in depth, and it is an old observation in the Weald that such a summer is always followed by a fruitful year; but, unless the hot and dry summer be followed by a wet autumn or winter, all draining is stopped, for men cannot dig such hardened clay, except to very great disadvantage.

Wheat is at all times the main object of the Wealden farmer, and to this crop he gives all his manure, besides a summer's fallow, which is thought to be the only true way, though when trusted in too much it is called "dressing with the plough-share." Before May is out, some farmers begin to prepare for wheat by breaking up a piece of land which has been left in bents for a year or two; or perhaps a piece of clover, which was first mown and then allowed to stand for seed. Heaps of poor manure are set about it, and exposed to the sun and rain for weeks together; then they are ploughed in, harrowed, and rolled. There are cases in which the land has been cropped in this manner with wheat till it yielded only about 10 bushels an acre after a fallow. This crop is followed by oats, after a miserable crop of which the land, foul and exhausted, is again left for a year or two to rest. There is much to be said in favour of a summer's fallow for wheat on a soil that cannot, like the light lands of Norfolk, be worked at almost any time. By means of it one is sure to "*make a season*," as the phrase is here,—that is, have some favourable opportunity of getting the seed into the ground, and thus ensure a good plant. Under favourable circumstances—that is to say, when an early harvest is followed by a fine autumn—a two-year course may be pursued, taking wheat alternately with green or root-crops; or in some cases, barley may be taken on a wheat-stubble with advantage, sowing in February or March on land ploughed before winter.

One hears sometimes of 40 bushels of wheat per acre being grown in the Weald, and I have heard of instances in which 60 were grown, but they are rare. Of course, every farmer would prefer 40 bushels an acre to 16, yet it will commonly be found that the smaller produce is superior in quality to the larger one.

Narrow, shaded fields of cold clay can produce very little, but when cleared of hedge-row timber, drained, and manured, the same land is capable of bearing large crops; for by the general

consent of those who know it best, this soil is most grateful for good treatment, and has in a striking degree the valuable property of retaining manure. The effects of manure may be seen for seven or eight years, and there are many well-attested instances of such effects being visible for a still longer time.

I know of a little farm in the Weald of 25 acres, which had for many years been sparingly manured and over-cropped till it returned no more than the seed, or about 2 bushels an acre. A tanner bought the place, and began by draining; this he did with horn piths, cutting the drains about 2 feet deep and 25 feet apart. He then improved it year after year by high manuring, which soon began to tell, and he grew more and more till at length he reaped 52 bushels per acre. He has been dead more than twenty years, and the farm has been occupied by several tenants, yet it still shows plainly, when compared with the surrounding land, that it has not forgotten the tanner's high-farming. The increase from 2 to 52 bushels per acre is highly instructive.*

On old arable land, in several parts of the Weald, lime has been used too frequently as a substitute for manure, the place of which it cannot supply. On new land, however, it is indispensable, and in land which for centuries has grown only oak-trees there is a sourness which quicklime neutralizes, while it converts what was noxious into food that is wholesome for plants; 100 bushels of quicklime to the acre is a good dressing, and by the time it is spread this may cost about 6*d.* a bushel.

Wheat of the first quality can only be grown on land that has been limed at no very distant time; indeed, it seems that all soils are less fruitful which contain no calcareous matter, and to pasture it is absolutely necessary. Chalk I have applied on this clay without any perceptible effect, good or bad; it was put on grass, wheat, turnips, and beetroot, without any difference being seen in any crop during four seasons.

With plenty of manure anything reasonable may be done: without it, nothing. But the question is, how to get the manure; for though some may be bought, the main supply must be made by keeping live stock and growing green and root crops for them. These are fully as valuable here as they are on lighter lands, and though not so easy to raise, nor in adverse seasons to cart off the land, they are of excellent quality, and must, in the course of a few years, be grown all over the Weald, as they now are in some parts of it. Cattle and sheep must be fattened, and

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* In his 'Notes on North America,' vol. i. p. 359, the late Professor Johnston mentions some remarkable instances of the long-enduring fertility of some of the old abbey and other church lands in England.

the food grown on the farm profitably eked out by the addition of a portion of artificial food, which will repay itself in more ways than one, for manure made from good food goes twice as far as that made from what is inferior.

Some clay may be burnt in order to be used as a manure, but, to effect any good purpose not less than from 80 to 100 loads an acre ought to be used. By *loads*, I mean one-horse cart-loads, and this will cost from 40*s.* to 50*s.* an acre, which would buy guano for two years, so that this is by no means a cheap manure; but it lasts many years, acting mechanically on the clay, which it opens. It seems especially suited to the tare, which grows vigorously on the clay, and there is no better way of enriching the land than by feeding off a good crop of tares with sheep. Guano appears to have no good effect on tares that are grown on the clay. Burnt earth is here called "Denshire ash," that is, Devonshire, from whence the practice of burning was probably brought hither. Where a full allowance of it is applied the land becomes darker and consequently warmer, so that the wheat grown on it will be fit to cut somewhat earlier than that on the same field which has had no burnt earth. In burning the earth, the heaps should be made of moderate size, but it requires practice to do it well, and most labourers in a country abounding with wood are apt to use too much fuel and to make the heaps of earth too large. The heat then becomes too great, and there is comparatively little good effected. The clay has such a tendency to burn that, when once on fire, the heap may be increased almost without limit and without any additional fuel, the clay itself burning fiercely. The spots on which the heaps have been burnt are very visible in the succeeding corn-crop, for there the wheat is of a darker colour, and is very apt to be laid by reason of the overmuch food in the soil, probably for the most part vegetable ash.

Burnt earth is excellent for spreading in stables, cattle-sheds, and sheep-sheds, where it absorbs the urine, and, being kept under cover, it is ready for use at any time, and has the advantage of being free from the seeds of weeds.

In bringing stiff land covered with oaks into cultivation, many loads of roots and stools of trees will be left on hand and cannot be turned into money. Having scores of loads of such fuel, I caused some to be made into charcoal, and applied it to land which had long been under cultivation and was then preparing for beet, reckoning load for load as so much yard-manure. The whole field had besides $2\frac{1}{2}$ cwt. of guano per acre applied immediately before the last ploughing. This trial of charcoal was made in two successive years, and in both years the char-

coaled part of the crop was superior to the rest of the field which had yard-manure; the plants were more vigorous, of a deeper green, and of larger size, but these effects were not seen after one crop. The application of charcoal might not be beneficial on some soils, but under certain circumstances it is worth trying.

Road-scrapings are frequently bought by farmers, who use them as manure, and in so doing cart a vast deal of worthless material on their land, besides the seeds of many road-side weeds. One would think that, even if they had such manure at a gift, it would hardly pay for the expense of carting; but it is done where little else can be done on farms when no stock is kept. Professor Buckman, in his paper on 'Agricultural Weeds,' Royal Agricultural Society's Journal, vol. xix., justly remarks that, "however particular we may be in trying to subdue weeds in our cultivated fields, yet waste places and way-sides, where many species like to dwell, if not attended to, will afford a nursery for many of the most objectionable." What nurseries for thistles may be seen on the road-sides throughout the Weald! Acres and acres of land, varying in breadth from a few yards to several rods, not merely wasted, but actually injurious, as they send forth yearly their myriads of winged seeds which take root far and near, and are most difficult to eradicate.

In every part of England much manure is wasted by exposure to the air and to every fall of rain and snow. Dark streams of liquid manure pour down many watercourses to utter waste, and the annual loss to the farmer is very considerable. But this defective management has attracted its due share of attention in most parts of the country, and is in a fair way of being cured; loose boxes have been made for cattle, and even whole yards have been covered in, and sheep-houses have been constructed where the land was too stiff to bear the tread of sheep in winter or in wet weather.

The consumption of guano and superphosphate of lime is steadily on the increase in the Weald. Very few years ago guano was so little known in this neighbourhood, that the keepers of gates demanded toll on it, not being aware that it was exempt. Still the general unproductiveness of the district is striking. You see light, thin crops of wheat and oats, nearly all the land undrained, large wooden barns half filled, and very few stacks of any kind. You meet very few cattle or sheep at any time on the roads, and see but few in the markets or on the farms. The gross produce is small, and the net produce, either in corn or cattle, smaller still. Yet this is not the fault of the land.

To what causes, then, is this state of things owing? Clearly to bad management of both landlord and tenant.

The Weald abounds in beautiful scenery, and certainly this is much owing to its being so thickly wooded, for the trees in leaf in a country of hill and dale have a beautiful appearance, but to the farmer they tell a tale of smothered crops and half-filled barns. An American gentleman, well acquainted with country matters, on first seeing the Weald in the spring of 1849, exclaimed, "All this shows a very low state of agriculture!" Since this observation was made, I have seen many shaws cut down, grubbed, and cultivated, and many small fields enlarged by throwing down useless fences.

Where the oak woods of the Weald are left in large masses, they interfere little with the common course of husbandry, but where trees are left standing in shaws and hedgerows, they destroy thousands of acres, so far as the farmer is concerned. In the Royal Agricultural Society's Journal, vol. vi., Mr. Grigor estimates the unnecessary fences in the county of Norfolk as taking up full 32,000 acres of land! I know of no estimate as to the loss of land in Sussex, but that it is very great no one can help seeing who has kept his eyes open in passing through the Weald.

In some parts of England hedgerow timber is grown at the expense of the tenant for the benefit of the landlord, but here it is grown to the injury of both parties. A crop of timber comes but once in a lifetime, and now sells so low as to make it a wretched investment for money. A crop of coppice-wood may in 7 years sell for 5*l.* an acre, whereas the same land if well tilled, limed, and manured, would produce in the first year four quarters of wheat per acre. Many parts of the Weald have been covered with oaks from time immemorial, and it may be fairly said that the land is now sick of the crop, as it would be under any other system of constant cropping with the same plant, and consequently there are thousands of oaks to be seen in Sussex which have no vigour of growth. All trees are here cut down with the saw, and the stump, though quite level with the ground, is called the *stem.* This stem throws up shoots all round; the strongest is frequently left, and the rest cut off with the bill-hook. In time this shoot becomes a worthless tree, called a "*stemmer*," which after a few years' growth stands still; yet such may be seen on many estates, though they have paid nothing for thirty years' growth.

The elm seems quite at home on the oak-tree clay, and both lime and beech grow well on it, but not so either the ash or the sweet chestnut. Pines and firs seem to grow but slowly, and

are evidently not adapted to the soil. The Service or Sorb becomes full-sized timber, and is a very ornamental tree, but the wood is not of much value; it bears an abundance of pleasant acid fruit, which is sold by the country people. The common gorse or furze grows freely, and is left on many farms as a cover for game, but no use is made of it as food for horses or cattle.

Apples are grown in every garden, and bear well; a good deal of cider is made, and some perry. Plums, cherries, and all stone-fruit bear remarkably well. The grape-vine bears enormously; not only the walls, but the roofs of many cottages, may be seen covered with this plant, and wine is made of the fruit by all classes of people.

The habits of the labourers show the nature of the country; plenty of men are to be found who can use the axe, the saw, the bill-hook, and tools for rinding the oak timber most dexterously; but it is not so easy to find men who can handle a turnip-hoe, or who can set out plants either on ridge or flat work. There are many farms of 80 to 100 acres with not a field upon them containing five acres, and these little enclosures of the most irregular shapes must be ploughed at great and needless expense; but a still greater evil is that their productiveness is destroyed by over much shade and moisture, as the wide, straggling shaws never allow the sun to shine on them except for a few hours in the middle of the day. The headlands, too, upon which the shaws gain yearly, are not only robbed by the roots of the trees and injured by their shade, but are trodden upon at every turning of the ploughs and harrows, so as to be of very little use. The expression in the Weald is, that such fields are *housed in* with trees: in the middle the wheat-straw looks of a good colour, but on the sides of every such field the straw is faint and unripe, and the produce of grain small and inferior. In harvest-time all crops, whether loose or bound in sheaves, are ready to cart, in open lands, hours before anything can be touched in small fields surrounded by trees. This is a serious annoyance to the farmer, especially in wet seasons, such as those of 1848 and 1852, and nothing except the force of habit could make him endure such nuisances. He hires land capable of producing 40 bushels of wheat per acre at the apparently low rent of 10*s.* or 12*s.*, but the shaws and coppice-wood are measured in, so that, in fact, he pays the full value of the land.

A field of four or five acres, all *close land*, that is to say almost impervious to air and water, undrained, and surrounded by shaws of oak and underwood, is as nearly unproductive as any land can be; even during a long fallow the sun and air cannot act upon it, and the wet can only be carried off by slow evaporation—a

process most destructive to wheats in the spring, and of course at harvest time.

Many farms in the Weald are carried on with capital incredibly small, and there are not a few farmers occupying from 50 to 200 acres who never think of fattening a beast, or even a sheep; but this is becoming less the case than formerly, and in this respect, as in many others, a progressive improvement is very obvious. The small farmers generally keep two or three cows, cross-bred animals with some Sussex blood in them, ill-made, and bad handlers, but useful as dairy cattle. The pigs are generally good, but are not kept in any great numbers.

It is a common practice in the Weald for farmers to take in a score or two of Kentish lambs to pick about the land from Michaelmas to Lady-day, at about 6*s*. each, and in order that they may not lose the little poor grass which they yield, the farmers do not plough their stubbles till late in the spring. The lambs have the run of the farm, fences, shaws, and all, picking up just what they can find, and occasionally having a little inferior hay given to them; but in this wretched manner they benefit neither themselves nor the land. Southdown lambs are, I believe, never put out in this way.

In consequence of keeping so little stock, farmers have not much to do in the winter, and if more stock were kept, better buildings would be absolutely necessary, for many farms in the Weald are but ill provided with dry warm sheds against the storms of winter, though of all things such provision is one of the most useful. Bakewell, many years since, put this in a very few words—"*Good lodging is as much to a beast as his food, and it is a great deal cheaper.*"

A sheep-farmer on light land may make shift with few buildings, but where cattle are reared and fed, and the manure from them has to be taken care of, good buildings must be provided, or the most cannot be made of their food. Landlords can never reap the full benefit of their properties till they improve them thoroughly. Useless fences and shaws must be swept away before the land can be drained to any advantage, and roads must be made to and on every farm; for it is a fact that there are farms which actually have no road leading to them, and where the occupant, even though owner of the soil, can only cart to and from his land by the sufferance of his neighbours.

Making good roads in a country of stiff clay must always be attended with considerable expense, more especially when flints are only to be had from a distance. Sandstone, it is true, is found imbedded in the clay at different depths all over the Weald, but though this is the material chiefly used for road-

making, it is a poor substitute for flint, and is soon ground to powder where there is much traffic.

No man, unless he be wilfully blind, can avoid seeing how imperfect all agricultural practice is, even at the best, and how much that is important still remains to be discovered. There are very good farmers in the Weald, but they are not the majority; and, looking at things fairly, it is evident that on the undrained and shaded lands of the Weald, a tenant farmer, who has perhaps no passable road to market, but only a clay lane through which horse and man can hardly travel for many weeks in the year, *must* go on summer fallowing for wheat, *must* be content with few or no green crops, and *can* keep but very little live stock.

The ploughs used in this part of the country are generally very heavy and clumsy, causing a great loss of power. Three, four, and even more horses are worked at length, while a man holds the plough and a stout lad drives the horses. In whole counties four-horse ploughs have given way to lighter and better implements drawn by a pair of horses abreast; this is especially the case in the northern counties of England, and all over Scotland. My own experience of nine years convinces me that, except on some undrained lands, or after long-continued wet weather, *a pair of good horses will plough the stiffest Wealden clay*, each ploughman driving his own horses, and ploughing an acre in eight hours.

Mr. Caird, in his 'English Agriculture,' after describing the two-crop and fallow system of the clays of Durham, proceeds thus:—"No root-crops are cultivated, and no purchased manure or food made use of. The farms are small in extent, the farmers hard-working and industrious, but without means, and strongly prejudiced in favour of their old ways, though these have yielded them nothing but ill-requited toil. They keep very little stock, which being ill-fed, the manure made on the farm is merely rotted straw. The yield of their wheat crop may be from 12 to 20 bushels an acre, 15 being a full average for the undrained lands, and their oats from 20 to 30 bushels."

It is singular that so striking a resemblance should exist between two counties separated as Durham and Sussex are, by the whole length of the island, but it must be observed that the resemblance is confined to the clay districts only of each county.

More has been done in Great Britain in improving live stock by selection and feeding than in any other country, and such men as Bakewell and Collins have added millions to the wealth of the country. But much yet remains to be done, and the breeders of inferior stock would benefit themselves and the public could they but assimilate their management to that of our best stock

farmers. An ill-made animal, light in the hind quarters and in all the best parts, coarse in the grain of the meat, and with a hard, thick skin, will consume vast quantities of food without any proportionate increase of value; and thousands of Welsh, Irish, and even English cattle are fattened annually at very little profit compared with what well-bred stock would have produced—for good beasts will frequently leave more *profit* than bad ones are worth. Dickson, in his 'Breeding and Economy of Live Stock,' gives the following rough calculation of the national loss caused by breeding bad cattle:—"Out of the 4000 cattle in Smithfield any Monday morning there will be fully 1000 of the most inferior description—the coarsest brutes imaginable. It may with confidence be asserted that there are at least 50,000 of these inferior cattle exposed annually in Smithfield market. Reckoning that better-bred animals would realise a pound more to the breeder (a very low estimate indeed), a clear yearly loss of 50,000*l.* thus arises from sheer neglect in *one* market alone.* What, therefore, must be the loss to the whole kingdom from this palpable neglect, which could easily be remedied by a little more care and at a trifling expense?

Fattening cattle singly in loose boxes may seem expensive at first, but in the end the expense will be repaid by the better thriving of the beasts, and by the complete preservation of the manure. When fed loose in yards beasts drive each other about incessantly, much food is wasted, and the weaker animals thrive slowly till the stronger ones are removed; but if carefully fed in single boxes, 20 beasts will not eat more than 18 would whilst running loose in one or two yards. A beast tied up by the neck, with barely room to lie down, suffers much from the constrained position he is kept in, for every animal has at times a degree of restlessness and irritation about him which is only curable by change of position.

The beautiful and excellent little bullocks from the Highlands of Scotland are too pugnacious when kept loose in yards to be profitable to the farmer, and they cannot bear being tied up and deprived of all locomotion; but if fed singly in boxes they can neither hurt nor molest each other, whilst they have freedom enough to enjoy themselves, and can lie down and chew the cud and fatten.

The well-bred, quiet shorthorn, whose grazing qualities are seen in perfection in a loose box, is still better suited to this mode of feeding than smaller animals are; for the rent of the

* No estimate is here given of the loss accruing to the *feeder* of these inferior animals. 5*l.* per head would not, in my opinion, be at all a high estimate of the joint loss to the breeders and feeders of such coarse, ill-bred cattle as those above mentioned. This would amount to an annual loss of a quarter of a million sterling on the stock shown in Smithfield market alone.—H. S. Thompson.

box has to be considered, and it is obvious that the tread of a heavy beast will pack more manure into the same space, and that there is more value kept on the 10 feet square. There is another great advantage in box-feeding, namely, that you can at any time take a beast out and put another in his place, which cannot be done in a yard common to all.

Cattle-boxes, each about 10 feet square, and 2½ deep for the cistern part, thoroughly well made with 9-inch brickwork and the rest of timber, with a good slated roof, may cost about 10*l.* each, and I believe that the more rapid growth of the beast and the gain in the quality of manure will pay fully 1*l.* a-year for each box.

In hot weather I have found it an excellent plan to whitewash the outside of the slate roof, for by so doing the boxes are kept cool, and the comfort of the beasts is much increased at very small expense.

As far as my own experience goes, I believe sheep to be the only stock fit to stand on wooden floors; they cannot be kept on clay in the winter or during long-continued wet seasons without danger of foot-rot; but in pens raised two or three feet above the ground, their feet will always be dry, they will fatten faster than on any land in the open air, and the manure will be kept under cover.

Pens of about 10 feet square will contain from 6 to 10 sheep, according to their size. If the floors be made with slats or stout laths, two inches in width and three-quarters of an inch asunder, they will always be clean and dry. I have used *sawn* oak-laths for the flooring of my sheep-pens, and found them answer the purpose admirably, being very strong and tough. The ground under them should be covered a foot thick with burnt earth or ashes, which must be added to from time to time, and the manure thus made is excellent for all purposes.

I must not conclude my remarks on Wealden farming without taking notice of the excellent fowls which are so prevalent in this district. The Dorking fowls are almost the only ones to be seen in the farmyards, and as great pains are taken in their selection, and much care is bestowed on their breeding and treatment, they have been brought to great perfection. Seven or eight pounds is not an uncommon weight for a capon, and they sometimes reach as much as ten or eleven pounds. The Dorkings are good layers, are peaceable in disposition, and very tame—so that they fatten easily. Turkeys are hardly ever kept in this part of the Weald, from an erroneous idea that they will not do well here, but, though probably a light soil may suit them better when quite young, I have had no difficulty in rearing them, and have found them do quite as well as in Norfolk.

Hayes, near Horsham, Sussex.

IX.—*Observations on the recently-introduced Manufactured Foods for Agricultural Stock.* By J. B. Lawes, F.R.S.

In common with other agriculturists I have been invited, by advertisements in the papers, by placards on the walls, and by circulars containing numerous testimonials from distinguished persons, to employ certain manufactured foods in the feeding of the animals on my farm. These foods frequently cost from 40*s.* to 50*s.* per cwt. Taking, for those for which it is given, the published average prices for the 6 weeks ending July 17th, 1 cwt. of the following stock foods would cost as under:—

	s.	*d.*
1 cwt. barley	8	4
,, oats	9	2
,, beans	9	4
,, peas	9	6
,, lentils	10	0
,, oilcake	10	0
,, linseed	16	6
,, hay	4	0

The manufactured foods thus cost, weight for weight, 4 or 5 times as much as the most nutritive of the ordinary stock foods on our farms.* Very undeniable evidence of the superiority of the former should therefore be required, to induce the farmer extensively to employ them. But it is rather strange that among the numerous testimonials in general terms, no evidence based upon exact comparative experiment, showing actual weights of food consumed and increase in live-weight obtained, has been brought forward in favour of these costly foods; nor does a reference to the circulars give much insight into their composition.

We do, however, in one circular, find the report of a Professor of Chemistry, stating that the food sent to him for analysis contained, besides nitrogenous and mineral matters, upwards of 50 per cent. of respiratory matter. It is further added, that if given to cattle in the proportions stated in the prospectus they *must thrive.* In reference to the above statement of composition, it may be observed, that it would apply almost equally well to any of the substances, except the hay, in the foregoing list of ordinary foods, which cost only about one-fourth or one-fifth as much.

The following is the result of an analysis in the Rothamsted

* Of course the relation will vary with the market prices; but the prices *per cwt.* can at any time be easily calculated for the purpose of the comparison.

laboratory, by Mr. Segelcke, of one of these foods. A practical trial of the same food will be noticed further on.

Water	12·86
Nitrogenous substance	15·51*
Fatty matter	6·22
Starch, sugar, &c.	55·97
Woody fibre	5·50
Mineral matter	3·94
	100·00

* Nitrogen 2·45 per cent.

Independently of the slight colouring with turmeric, and flavouring with cumin, anise, or other of the stimulating and carminative seeds used in cattle medicine, which these foods frequently exhibit, the constituents as here stated, could be supplied by a mixture of barley-meal with some of the leguminous seeds enumerated, and oilcake or linseed. Such a mixture, according to the prices quoted, could be prepared for about one-fourth the price of the manufactured cattle-food.

These foods are recommended to be used in comparatively small proportion to the total food consumed. The animals have, therefore, still to rely for the bulk of their nourishment upon ordinary food ; and it is stated that, with the use of these manufactured foods, the quantity of corn may be reduced to about one-half; and that coarse and comparatively innutritious matters, such as bran and chopped straw, will, by the admixture, be rendered palatable and nutritious.

Now bran and chopped straw contain a large proportion of woody fibre; which, though required for bulk by the ruminant animals, passes through their bodies in a finely-divided state, but otherwise almost unchanged. More or less of the soluble matters are extracted from such food during its passage ; but no evidence has been brought forward to show that these manufactured foods will so stimulate digestion, as either to extract more of its already-existing nutritious matters, or to render the woody fibre itself, of the coarse foods mentioned, more directly serviceable to the nourishment of the animals.

All animals require in their daily food a given amount of digestible and convertible constituents ; such as starch, sugar, pectine, gum, oil, nitrogenous compounds, and certain mineral matters. The proper amount of some or all of these *must* be contained in the food supplied ; and no stimulant, or any other device, can substitute that necessary amount, if the animal is not to decrease in weight. If, on the other hand, the animal be required to increase in weight, as in the case of our growing and feeding stock, an additional amount of digestible and assimilable constituents is required, beyond that which, under otherwise

equal circumstances, would keep the animal at a fixed weight. In fact, no stimulus whatever can substitute the supply of the digestible and assimilable constituents in the food, whether it be required for the purposes of labour, or of increase in weight. In other words, the waste of matter in the body by respiration and perspiration, the loss by urine and fæces, and the gain in weight of fat, flesh, bone, &c., must all come from constituents *actually contained in the food.*

Some years ago an extensive series of experiments was conducted at Rothamsted, on the feeding of oxen, sheep, and pigs, most of the results of which have been published, either in the Journal of the Royal Agricultural Society of England, or in the Reports of the British Association for the Advancement of Science. These experiments showed how much the character and productiveness of the foods employed depended upon the amounts they supplied of certain digestible *non-nitrogenous* substances, such as starch, sugar, fatty matter, &c., certain *nitrogenous* substances, such as albumen, &c., and certain *mineral* matters. It was further found, that the ordinary or staple foods, when in proper admixture with one another, supplied the several constituents far more economically than when mixtures were attempted to be made, in which some of the constituents (starch, sugar, or oil, for instance) were employed in a comparatively pure state; that is, after having undergone an expensive process of manufacture in their preparation. Indeed, unless fresh and cheaper sources of food can be discovered, so that we can be supplied with starch, sugar, oil, &c., at a cheaper rate than they are provided in hay, corn, oilcake, and the like, we cannot hope economically to replace the latter by special manufactured foods for stock.

It may be asked—if we can with advantage employ concentrated manufactured manures for our crops, why cannot we also economically employ concentrated manufactured foods for our stock? The answer is plain. In using the concentrated manufactured manure, containing a certain amount of nitrogen or phosphates, for example, the bulk of the crop is obtained from *other sources*—such as the *atmosphere and water*, not supplied by the farmer's hand; the *natural constituents existing in his soil*, and the *residue from previous manures and crops.* The application of a small quantity of ammonia and mineral matter will often yield as great an increase of vegetable produce, as if 20 or 30 times the weight of farmyard dung had been employed. This is not to be wondered at when it is considered, that by far the greater bulk of the dung consists of water and other constituents which the plant can obtain either from the air or the soil. We thus get, by the use of concentrated manures, a much greater

weight of increased produce than there was of manure employed. The case is very different in the supply of food to our stock. The quantity of the constituents returned in the solid and liquid excrements, and in the increase of the animal, must invariably be very much less than was contained in the food consumed. No concentration of constituents, nor any amount of supply of some only, of those required for the *respiration*, the *perspiration*, the *excrements*, and the *increase*, can enable the animal to obtain a particle of what is requisite for these, from any other source than his food.

In the case of stock-foods therefore, the scope for economical manufacture or concentration is very limited. Among the natural complex foods, hay may be said to be more concentrated than straw, and corn more concentrated than hay. Of the individual non-nitrogenous or so-called respiratory and fat-forming constituents of food, fatty matter is very much more concentrated than starch or sugar. But our ruminant animals cannot thrive upon exclusively concentrated food, even though it be so in the limited degree in which it exists in corn. They require a certain amount of the bulky but innutritious woody fibre, which they find already combined with other constituents in hay or straw. Those animals, such as pigs, which do not require the same proportion of woody fibre for their digestive operations, are provided with a suitable combination of starch, sugar, oil, nitrogenous substance, and mineral matters, already formed in corn and other natural foods, far more economically than they could be supplied with them by the intervention of manufacturing processes.

There is, in fact, only one manufactured staple article of food employed by the farmer with advantage on the large scale. This is oilcake. Even oilcake is not manufactured exclusively for the purposes of feeding: it is the residue of a process for obtaining oil, the value of which to a great extent meets the cost of the production of the cake. The cake was produced before there was any demand for it as food for stock. It would continue to be produced if the farmer did not so employ it. Its price as food is not regulated so much by the cost of production as by what the farmer will give for it in competition with other articles. It may be mentioned, however, that many of the recently-introduced manufactured foods cost four or five times as much, weight for weight, as our most nutritive oilcakes.

From all that has been said, it will be clear that these newly manufactured foods cannot substitute any of the necessary constituents contained in our ordinary stock foods any further than they themselves supply them. So far as the mere supply of alimentary constituents is concerned, a mixture of linseed or oilcake, and corn-meal, can provide these at one-fourth to one-

fifth the cost of the specially-made artificial foods. Such foods cannot therefore be relied upon as staple articles. The virtues which they really do possess over and above those which could be secured at one-fourth to one-fifth the price are confined, therefore, to the action on the health and digestion of the animals of the small amount of stimulating and carminative seeds which they contain. In fact, so far, they are sauce or medicine, rather than food. As such they are likely rather to increase than to diminish the appetite for further nutriment. Still it is quite possible that, if judiciously compounded, they may be of service in keeping horses in a more healthy state of body, or in aiding the digestive powers of weakly animals which do not readily consume and thrive upon the ordinary foods. It should, however, be clearly understood by the farmer, that these manufactured foods cannot do away with the necessity for a given amount of digestible and assimilable constituents in the collaterally-consumed ordinary food. There is, as yet, no exact evidence to show that they can, even in their office of condiments or medicines, enable the animals profitably to appropriate a larger proportion than they otherwise would, of the constituents of the other food they consume. That is to say, there is no proof afforded, that with their use there is either a larger amount of increase obtained for a given amount of food constituents consumed, or that a smaller amount of the food constituents passes off unused and effete in the fæces.

Below are given the results of the practical trial of the food, the proximate analysis of which has been already recorded. The plan of the experiment was as follows: 6 pigs were selected and divided into two lots of 3 each, the collective weights of the respective lots differing from one another by only 2 lbs. To lot No. 1 a mixture was given, composed of 9 parts barley-meal and 1 part bran. To lot No. 2 the same mixture of barley-meal and bran was given, with the addition of 2 parts of the manufactured food to every 10 parts of the barley and bran mixture. The food was in each case stirred up with hot water, and both lots were allowed as much of their respective foods as they chose to eat. The results of this comparative experiment were as follows:—

Description of Food.	Number of Pigs.	Duration of Experiment (Days).	Original Weight.	Final Weight.	Increase.	Total Food consumed.	Food consumed to produce 100 of Increase.
			lbs.	lbs.	lbs.	lbs.	
Lot 1. Nine parts Barley-meal, one part Bran . . .	3	28	357	496	139	547	393
Lot 2. Nine parts Barley-meal, one part Bran, two parts manufactured food . .	3	28	355	494	139	556	400

The amount of increase for a given quantity of food consumed was in both cases good. It is obvious, however, that so far from there being less total food consumed when the manufactured meal was employed, there were 9 lbs. more of the mixture eaten when one-sixth of it consisted of the expensive manufactured food; whilst the amount of increase in weight was exactly the same in the two cases. In fact, the results are so nearly absolutely identical that the difference cannot perhaps be fairly attributed to any intrinsic difference in the character of the food. But it is, at any rate, clear that nothing was gained by adding to the barley-meal and bran, one-fifth of its weight of food, costing about five times as much money.

The general observations that have been made above are, then, fully borne out by the results of this experiment. In conclusion, I feel bound to say, that I should require much clearer evidence than any that has hitherto been adduced, to satisfy me that the balance-sheet of my farm would present a more satisfactory result at the end of the year, were I to give to each horse, ox, sheep, and pig, a daily allowance of one of these costly foods.

Rothamsted, July, 1858.

X.—*Manuring Grass Lands.* By J. Dixon.

Prize Essay.

Having had more than twenty years' experience in the improvement of grass lands in Yorkshire, Lancashire, and Cheshire, under the great variety of circumstances in respect to soil and subsoil, altitude above the sea, and other natural conditions of surface which so peculiarly appertain to these counties, I have ventured to record my own practice, and what has come immediately under my observation in the practice of others, in this important part of agricultural improvement.

For the last twenty years I have had rather extensive opportunities of examining the results from the use of bones, and I have no hesitation in pronouncing them to be pre-eminent above all other manures for the improvement of grass lands when permanency as well as cost are considered. Some farmers prefer them boiled on account of their more immediate effect, and consider them equally lasting; but from my own experience, I am decidedly in favour of raw bones: only allow them to be ground fine, and the effect will soon be evident, particularly if thrown on the land in early spring, and in showery weather. Of the permanent power of the raw bone I can instance a case on land of which I was the tenant for sixteen years: it was old

turf, and had been in the occupation of the proprietors for a long time previous to my becoming tenant. The extent of the land in question was little more than twenty acres.

About the year 1790 the then proprietor had all the bones he could obtain in a commercial locality collected together, and broken with a heavy hammer. No account was kept of the quantity or value used on a given surface, but there is sufficient evidence to show that an unusual dressing was given.

The soil is of a close, tenacious character, lying on a clayey subsoil. The subsoil did not contain calcareous earth, at least it did not effervesce with the spirit of salts (muriatic acid). Some parts of the land had a more porous substratum, and were sufficiently dry for pasture: these particular parts were undoubtedly the most fertile land in the district. Such of the surface as was wet had scarcely any other vegetable covering than the carex and others of the coarsest grasses. It is perhaps proper here to state that this bone-dusted land has not been broken up or in tillage for a very long period. On becoming tenant, I immediately set about draining the wet parts. In this operation we found, at from five to eight inches from the surface, much bone, in various states of decomposition: the large pieces, when broken, appeared fresh inside. I felt at the time some regret that much value must have been lost for many years, and, as I then supposed, for ever lost, on account of the manure having been in a soil saturated with water ever since it had been laid on; however, before my draining operation had been completed twelve months, the coarse herbage began to disappear, and in its place appeared white clover, marl clover, and others of the best pasture grasses; and in the second summer after being drained the soil was equally luxuriant with the naturally dry parts of the land. It is now nearly seventy years since this land was boned, and it is still markedly luxuriant beyond any other grass land in the same district.

A great improvement by bone manure was effected by Captain De Hollenworth, of Hollenworth Hall, Cheshire, between the years 1840 and 1843. In those three years about 1500*l.* was expended on bones, principally boiled, and about 4*l.* in value was used to the acre. Boiled bones at that time cost 4*l.* per ton; raw broken bones, 7*l.* per ton. The land where the manure was used is nearly 600 feet above the sea; old turf; the climate does not mature corn well; character of the soil various, some peaty, on aluminous shale or stone; other parts a lightish grey soil, on aluminous slaty stone. It was on the latter description of soil that the bones effected the greatest change. The grass has sometimes been eaten off, and sometimes mown for hay. The quality of the herbage was totally changed within the first two

years after boning. Some of the meadow land which had been let at 30*s.* per acre was readily raised to 3*l.*, and still made more money for the tenant when turned either to the feeding and breeding of sheep, or the feeding of cattle.

A large tract of moor-land, which had never been in tillage, and which as a public pasture had yielded 5*s.* to 7*s.* the acre, after boning produced 17*s.* the acre.

The effect of the manure is now decidedly less apparent than it was six years ago, and is evidence of a fact I have frequently observed, viz. that manures are sooner operative and sooner exhausted on lands lying at high altitudes than when used in lower districts.

In the year 1841 Mr. Williamson, a tenant farmer residing at Huxley, near Tarporling, expended 374*l.* in bones, principally boiled. Mr. Williamson's farm is 50 miles south-west of Captain De Hollenworth's farm, and is about 60 feet above the sea. The whole of the bones were applied to grass land, at a cost of 2*l.* 10*s.* per acre. Mr. Williamson's pasture land has a peculiarly close-textured soil and subsoil, approaching nearly to the lias clay, though brown-red in colour, and effervesces violently when tested with spirit of salts. Previous to boning, the herbage on these pastures was of the poorest kind imaginable—there being few if any plants except the small carex; in the second summer after boning the carex had disappeared, and the pasture had become long and thick-set with white clover, cow-grass or marl clover, and trefoil. The dairy stock had also been increased from forty to fifty-two cows: the forty cows had been at times almost starved; the fifty-two cows had abundance, and more than they could feed down, and sheep were purchased for the excess keep. I inspected this farm in 1841 and 1843, under the direction of an Agricultural Society.

The bones used still show considerable effect on the soil, though much less value on a given space was used than on Captain De Hollenworth's farm.

In the year 1838 I inspected a farm 28 miles west of Captain De Hollenworth's. The altitude of this was about 80 feet above the sea. Up to August in that year 250*l.* had been expended in boiled bones (cost 4*l.* per ton); the quantity applied to the acre was about 16 cwt., the soil and subsoil being much the same as on Mr. Williamson's farm; the herbage growing on it of the same kind, but apparently more scanty. Several small fields had not been dressed with the manure, nor had any stock been in these fields during the summer up to the month named. So little, however, was the herbage, that I computed that not more than 20 stones of hay could be obtained from an acre. In 1839 I again inspected this farm, and the pastures showed con-

siderable improvement. The dairy stock on the farm the preceding year consisted of four cows, which had been increased to eight. It is proper to mention here that the land in question had been in grass for a long series of years, its wetness and natural cohesiveness having been a bar to any attempt at converting it to tillage. The extent of the farm in question is 98 acres. In 1842 the dairy stock on this farm was 24 cows, and in the autumn of that year 80 sheep were put on the land to consume the superabundant grass on the pastures.

In November, 1843, I again inspected this farm. The weather had been wet for some weeks, and I was sorry to see much good herbage on the land almost lost for want of the surface-water being properly carried off. Within the past two years I have been three times over this farm; it is still in a bad state from want of efficient drainage, and the bones seem to have lost much of their former effect.

In 1844 I went over a farm of 137 acres, lying about 10 miles west of that last-mentioned, and at nearly the same altitude. About one-half of this is strong soil on clay, and the remainder rather a light soil resting on red shale marl and soft red sandstone. Seventeen acres of this farm were very old meadow, 65 acres in pasture, and the remainder of the farm in convertible husbandry. The then and present tenant had commenced his occupancy in 1840, and in that year I made an inspection of the land and stock. The dairy stock consisted of 24 cows and 3 farm-horses: all the young stock had to be sent to a public pasture, as the land would barely keep the cows and horses. In 1844 the dairy cows were 30, farm-horses 4, heifers 11, with abundance of keep for all. To effect this improvement the tenant had in three years expended 300*l.* in bones, all applied to the 65 acres of pasture land, which is now in a highly productive state. The water was drained out of the strong and clayey soil; this, with the increased number of stock supported, seems to maintain a continuously fertile condition.

In a wide range of country around Crewe, Nantwich, and Church Minshull, extending to the city of Chester, the surface is now maintaining from 30 to 50 per cent. more stock than was the case thirty years ago; and the increase of cheese, the staple product of these districts, is in many instances in about the same ratio. Bones were used to a spirited extent twenty-five years since in the township of Minshull Vernon, and the effect shown there has given rise to great efforts in the right direction in several counties. I believe nearly the whole surface of the township just mentioned has been covered with bone-dust: it is a pastoral township, mostly devoted to dairying for cheese. The soil is strong, resting on a clayey subsoil, but neither the sur-

face soil nor the substrata are of that cohesive character, nor do they contain so much carbonate of lime, as we find under the thin-skinned, heavy land about Crewe, Cholmondeston, Calveley, parts of Tattenhall, Bolesworth, and Buerton, and other parts of Cheshire, Staffordshire, and North Wales.

On the better description of strong soils 12 to 15 cwt. of bones per acre has been found quite as much of a dressing at one time as could be safely applied, and several fatalities have occurred to stock feeding on newly bone-dusted land. The change of the quality of the herbage from a very poor feed of poor grass to a full bite of the richest herbage, mostly of the clover or trifolium tribe of plants, has caused cattle to become *hoven*, as is often the case when turned on rich crops of after-math clover.

Bones have been used on some grass-lands with less effect; but failure, or even partial success, has only occurred under peculiar circumstances or natural condition of the land, as, for instance, on lands situate near large towns or thickly-peopled localities, or on such very light sandy soils as rest immediately on ferruginous sand: on grass-lands near large towns which have for many years been liberally top-dressed with highly putrescent manures, bones do not show a very decided manurial action.

In the year 1837 I was in correspondence with the late Earl of Leicester, and in reply to an inquiry his lordship wrote me:—"Wishing to try the effect of bone manure on my farm at Holkham, I erected a machine for the purpose of preparing bones, but after a trial of three years I found the manure did not answer, although I had seen bones used with great success on the sandy soils in the county of Nottingham."

An opinion is held by some farmers, that if bone manure is applied to land which has been limed the bones have little or no effect, and that the lime neutralises the fertilising properties of the bone.

On that question I tried a limited experiment in 1848. I had used several hundred tons of lime in the spring months of that year on very old turf, the soil being sandy and resting on a substratum of sand, but not the fox-bench or iron-band sand. In the autumn of that year I bought 8 tons of raw bones which had been collected in a town, price 8*l.* per ton. These bones were taken by my own carts direct to a mill to be ground, and were waited for until they were ground. In September I applied half a ton of this manure to half an acre of land which had been limed in the spring, at the rate of 8 tons to the acre. The half-acre on which the experiment was tried is part of a pasture of 100 acres, and the boned part *to this day* is superior to the adjoining parts.

Bone-sawings, such as are made at the button manufactories,

and by comb and knife-handle makers, have always been found a most effective manure for grass-lands. None but the best and soundest unboiled bones can be worked for the purposes just named, consequently the sawings and chippings from them are very valuable. If applied in autumn, bone-sawings will produce an effect the following spring; and I know pastures now very good which were top-dressed at the rate of 8 cwt. per acre (price 9*l.* per ton), although ten, fifteen, and even twenty years have elapsed since the manure was applied.

Bone-sawings are readily adulterated, and no doubt have been so to a great extent, without the detection or suspicion of many farmers who have used them.

During the past year I have bought several tons of sawings from a button manufacturer: when I had taken about 5 tons, from several circumstances I began to be suspicious of some trick being played on me. I did not, however, then cease buying, nor did I institute particular inquiry. In a short time I sent for upwards of 2 tons more; and, upon a closer examination of the sawings, I was so far satisfied of being wrongfully dealt with that I sent a quantity to be analyzed at the laboratory of the Royal Institution, Manchester, and had the fol- account returned:—

"Sir,—The sample of bones left by you we find to consist of—

Organic matter	26·98
Water	11·56
Phosphate of iron, magnesia	2·01
Phosphate of lime	43·03
Carbonate of lime	6·84
Sand	9·58
	100·00

F. Grace Calvert."

Hearing that the high sheriff of the county of Chester had been dealing with the same party, I put myself in communication with him, and to my first inquiry received this answer:—

"Sir,—I have had transactions with the party you name, which have not been of a satisfactory character; and I feel disposed to assist any one in showing up adulteration of manures, which I fear is nearly universal.

"Most truly yours,

"Dec. 24, 1857." "Wm. Atkinson.

In a second communication from Mr. Atkinson, he writes:—

"The last bones I had from the same party showed by analysis near 10 per cent. of silica or sand, or as below:—

Water	8·0
Matter, organic..	27·4
Carbonate of lime	5·1
Phosphates	49·3
Silica or sand	9·96

"From the above you will perceive the proportion of sand, which exhibits chiefly in the small powder-like portion of the bones, is much larger than it ought to be. The above examination was made at Chester College. The bones were not sawings, but ordinary raw bone. I had transactions with this man some years ago of a less satisfactory result than the last; but, from mismanagement, I was not in a position to make out a proper case, though to myself it was clear as day. I hope you will succeed in bringing him to justice.

"Yours most truly,

"Dec. 28, 1857." "W. Atkinson.

In a wide range of country round Knutsford, and extending to Chester, there is perhaps not more than one-fifth of the land in tillage: it is a great dairy district. Bones have been used here to a great extent, and with great satisfaction in every instance which has come to my knowledge.

I was over a farm in the township of Toft, some weeks since, of about 160 acres in extent. The present tenant has occupied it for ten years; the first year he expended 300*l.* in bones, which were applied to pasture land at the rate of 15 cwt. to the acre; the price of the bones being 7*l.* 10*s.* per ton. The whole of this farm has been bone-dusted; and a great proportion of it, at least the pasture, has had a second dressing of about 8 cwt. to the acre. The stock formerly kept consisted of 20 dairy cows, and 3 or 4 horses and colts. On this farm there were depastured the last summer, 35 dairy cows, and 8 feeding ditto, with 16 head of young stock, besides 5 horses and 3 colts; and one-fourth of the farm is in tillage. Similar results have been produced on almost every farm in this neighbourhood; and, indeed, all over the grass-lands in the county, where bones have been applied, although the soils and subsoils are as varied in natural character and appearance, and apparent fertility, as can be imagined to exist in any one section of a country—from good strong loam resting on red sandstone, and soils of good staple resting on clay or on a mixture of clay and calcareous gravel in different proportions, to the very poor cohesive surface resting on a bottom of clay mixed with calcareous earth, so close and unbroken in its texture as scarcely to admit of water percolating into it.

Bones are at present scarce at the importing towns, and few now reach this country from abroad which have not had a considerable quantity of the more soluble constituents, *fat* and *gelatine*, taken out, as these particular parts of the raw or fresh bone are extensively used in the manufacture or the finishing of various

fabrics in our commercial districts. Twenty years ago I bought scores of tons of boiled bones at 3*l.* 5*s.* to 4*l.* per ton; the price is at this time 5*l.* 10*s.* to 6*l.* per ton: imported boiled bones are sold at 7*l.* to 9*l.* per ton; and sound leg and thigh bones, used by button-makers or for knife-handles, at 14*l.* to 18*l.* per ton. I always prefer using boiled bones soon after they are taken out of the digester. In that state they are wet, and of course heavy in proportion to their bulk. Many farmers would rather have this description of bones more dry, which they will soon become if allowed to remain in a heap of many tons together; but in the fermentation and drying which take place under these circumstances I have always found a corresponding loss of power in the manure.

Lime is extensively used in many parts of England and Scotland for top-dressing grass-lands not intended for tillage; and also on lands in tillage on clay soils it destroys to some extent the cohesive character of the soil, making it more porous and easy to work. On very dry grass-land, subject to burn in hot weather, I have found great benefit from an application of 8 tons of lime to the acre. On sandy, ferruginous soils, containing much fox-bench or iron-band, it is a permanent benefit; this I know from at least twenty-five years' experience. In the years 1847, 1848, and 1849, I used more than 1000 tons of Derbyshire lime: it was brought by water-carriage about 30 miles, and cost 12*s.* per ton. On the side of the grass-park, on which most of it was used, 108 acres of extremely poor old grass pasture were covered over in three years with about 8 tons to the acre. The subsoil for the most part was a poor arid red sand, nearly such as is used for building purposes. The surface soil had a very light vegetable covering, mossy and almost like wild moorland. The whole extent of this grass-park at that time was 280 acres, lying at an altitude of nearly 400 feet, and appropriated as a public pasture for cattle. The average yearly receipts from the cattle on this pasture for ten years previous to a great breadth of it being limed,* were 126*l.* In 1848 that portion limed in 1847 was much improved, and more stock was put in the pasture. A marked improvement from the lime was always seen in later autumn, if applied in spring or the early summer months. In 1850, 420*l.* was received from parties having cattle in this

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* Sixty acres were covered with compost of peat-earth, night-soil, and sweepings from the streets of Manchester. These manures are sooner in full action than either lime or bones, but of shorter duration; they cost about the same per acre as lime, taking into account horse and other labour. We dressed with 26 cart-loads to the acre. I prefer using putrescent manures on grass lands in the spring or autumn months, at a time when there are indications of rain after dry weather.

ley. Wishing to try the effect of lime of varied character and from different works, in 1850 I purchased 100 tons of Derbyshire lime, 100 tons from Clithero and Chatburn in Lancashire, and 50 tons from the Knottingley Works near Pontefract in Yorkshire. The Knottingley lime is made from a slaty stone, or stone which rises in the quarry in layers of various thickness: it is rather yellow in colour, and, according to an analysis which I have seen, contains magnesia and a little sand. The lime from Clithero and Chatburn is rather blue; the Derbyshire or Buxton lime whiter, and of lighter specific gravity, than the other limes. It should be here observed that, from my own experience and the practice I had seen on a great extent of old grass-land in the district of Craven, in Yorkshire, I had begun to allow the lime to become to a certain extent effete, or in a damp powdery state, before spreading it on the land.

The lime from the different places last mentioned was used on very old turf, naturally not quite so poor as the 108 acres last mentioned. The quantity used was 8 tons to the acre, as in the former experiment.

The land was in slightly convex ridges, about 20 feet wide. We commenced with Buxton lime, and covered one ridge with Buxton and one with Clithero alternately, until 50 tons of each had been used. We then began with the Knottingley lime, covering ridge for ridge with the different sorts. All the different limes have produced a most beneficial effect. The mossy and moorland benty grasses have disappeared, and the surface is now fine and green, with better herbage, including white clover and cow-grass. A stranger walking over the land could, I think, scarcely detect any difference on the ridges; but there is one fact in favour of the Buxton lime—it falls to powder in less time than the limes from Clithero or Knottingley. The most important fact is yet to record: in 1855 the receipts from cattle in this public pasture were 620*l.*

Lime, by small farmers, or persons not using it on a large scale, is frequently made into compost with any soil or refuse about the farm; but, as a general practice, I do not consider it an advantageous mode of applying lime. Under some circumstances, however, cohesive material thrown out of drains may be mixed with lime to good purpose.

In the year 1845 a gentleman purchased several hundred acres of land in small farms, all lying in a district of country about 600 feet above the level of the sea, neither the land nor its occupants being in a position to help one another. But the gentleman* wishing to see the land of his early days wear a more

* E. Buckley, Esq., M.P. for Newcastle.

pleasing appearance, even at great cost, the thing was to be attempted. It was almost to an acre old grass land, as corn at that elevation will not often reach maturity. I was engaged to direct the remodelling of the fields, and the manuring of nearly all the property. Most of the soil lay on poor clay or shale, and lime was used to a great extent. Rather extensive draining was done on the clay land; and the material thrown out of the drains being of a soft and very cohesive character, we did not return it into the drains. It was mixed with lime; and our object being to destroy or reduce the nature of the clay, we put clay and lime together in about equal bulk: the lime nearly burnt the clay; to do that about fourteen days were required. The compost was then turned over altogether in a powdery state. In due course it was applied to the land, and in a few weeks there was ample evidence that the practice was correct. The compost acted sooner than lime alone would have done; it has been *equally*, or, I might say, to some extent *more* effective. About 1000 tons of lime have been used on these small farms, at the rate of 8 or 9 tons to the acre, and a great improvement brought about. The lime costs here 12*s.* per ton. It was brought thirty miles by water, and two and a half miles by carts. In one year after the lime had been applied, 10*s.* to 15*s.* per acre advance in rent was readily obtained. Bones have been used here to a limited extent, but unless applied in double the quantity sufficient for most lands in low altitudes the change is not satisfactory.

Since the extended use of bones for grass lands, either on old turf or land newly seeded down, lime has been much less used in some counties than formerly. Within the last three or four years, however, it has been more in favour. This is, perhaps, in some degree from the higher rate of bones, or the greater facilities for obtaining lime at reasonable cost by rail or water carriage. It certainly is a great help to all seed grasses, as well as to old turf, particularly on light ferruginous soils, or any thin-skinned land, which is apt to burn in hot dry weather. When used on newly-seeded land, it should be applied in compost, and not in a caustic state. On the arid sandy soil which I have limed, and which formerly was burnt up every hot summer, nothing of the kind has taken place since, the herbage retaining a rich green through the summer months.

With some who have used lime it does not obtain its due estimation as a help to land, merely from the fact of *an insufficiency having been employed.* If an objectionable condition exists, ample power is required to produce a change, and, in my experience, I have always found it the safest and soundest economy to obtain the effect at once, and not by niggardly or piecemeal applications.

Lime is now extensively used in the preparation or purifying of gas. After being used at gas-works it appears to be highly impregnated with sulphur, and requires judgment and caution in employing it as a manure. In the first place, it should be broken down to the fineness of sand. A small lump of gas-lime will destroy any of the trefoil or clover variety of plants. On grass land two tons to the acre is a safer application than a greater quantity;* it should be put on the land in December; and to assure uniformity and equal covering on a given surface, it is best to sow it with the hand. Some years ago I saw a piece, 20 acres, of newly-seeded land totally ruined by an application of gas-lime of 3 tons to the acre. No grass-seeds could look more healthy than on the piece in question, both luxuriant and thick in plant. The owner, and also occupier, had read some very favourable account of gas-lime, and, not being himself a practical man, determined to try its effect; the grass-seeds were all destroyed, and the land was ploughed up for a white crop.

Gas-lime at some places is given away, and I have never known more than 3*s.* per ton paid for it. I have used it to some extent, and have seen its application tried in several counties, with various success: but the failures have been from either putting too much on the land, or allowing it to be unevenly spread.

Putrescent manures, or manures raised about a farmstead, are perhaps the most common top-dressing for grass intended for hay, and for the improvement of pasture also. In many places, however, farm-yard manure is solely employed in tillage, for wheat, barley, or green crops. Guano is now used for grass, and of course the farmer employs less farm-yard manure in that way than formerly. I have used farm-yard manure in compost with soil, as well as garbage and night-soil from towns. Compost made up in this way produces an almost instantaneous change on poor old grass. Its effect, however, is neither so permanent, nor is it so easy of application as bones or lime, and certainly it is a more costly manure, under general circumstances, than either. But on grazing farms, such as those of the Craven district of Yorkshire, where few green crops are raised, and stall-feeding practised to a very limited extent, the farm-made manure is disposed of to help the grass lands, being the only means of employing it. There must be some uncertainty about any statement of the quantity, or, more properly, the weight of manure required as

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* I have found a much less quantity than two tons per acre act as a perfect poison to pasture-land, all kinds of stock refusing for several years afterwards to touch the grass where it had been applied.—H. S. Thompson.

a fair dressing for an acre, because the quality is so different, occasioned by the different systems of keeping stock: thus the manure made from horses highly fed, from piggeries, and from horned stock fed on corn, cake, and roots, is of more than double the strength or power of manure raised from stock poorly fed. All farm-yard manure, before being laid on grass land, ought to be so far reduced as not to appear strawey; and 10 to 12 tons, from cattle highly fed, is a fair dressing for an acre. The manure made at dairy establishments in towns is generally very good; so is that raised in stables where horses are highly kept for pleasure or severe labour.

The best time for applying farm-yard manure is in the latter end of September or in October, particularly in a showery time: as it soon gets a cover, and is then less liable to be damaged by the sun or drying winds.

Guano.—This is a great acquisition to the farmer; its price is now 13*l.* per ton, about 25 per cent. dearer than it was ten years ago. I generally use about 3 cwt. to the acre on seeds newly laid down for meadow or pasture. The best time for applying it is in January or February, if the weather be showery. If guano is sown on the surface, and a few days of dry wind or sun follow before the manure is washed in, its power is reduced by evaporation. A few months since I walked over a field of 20 acres of rather strong soil on gravelly subsoil. This field had been summer-fallowed, was in tillage and without help up to 1842: it was then laid to grass, but was so poor in 1845 that only twelve yearling calves were put on the field; six of these got out, and would not remain quiet on that pasture that summer on account of the poverty of the land. In the autumn of 1845 the occupier purchased, by accident, 20 tons of damaged Ichaboe guano at 3*l.* 12*s.* 6*d.* per ton, and applied the whole on the 20-acre pasture field. I may just observe that it lay in a good climate, about 40 feet above the sea. The effect from the guano was distinct in one week; and, in 1846, 240 sheep were well maintained and fatted on the 20 acres, with plenty of keep to spare. This identical piece of land has always been in high condition since: last year it was ploughed up for oats, and these, if anything, were over-luxuriant. Since the oats were taken off, the land has been ploughed twice, scarified, and sown with wheat, having had no help since the covering of Ichaboe guano.

Guano may be used much more freely on land to be pastured than if the produce is to be made into hay, as some facts will show. An agricultural society with which I am connected has, for a long period, given prizes for land newly laid down to grass in the best manner and with the best selected variety of seeds. The new turf is viewed the second year, in the early

part of June. I have, for nearly twenty years, inspected and reported to the society the merits of the different claimants. Guano has been liberally used by most of them, and sometimes with a damaging effect. The district spoken of, lying north, south, and south-east of Liverpool, is as well farmed as any part of England or Scotland; and there is spirited competition for the class of premiums just alluded to: seeds to the value of from 25*s.* to 30*s.* are sown to the acre, consisting of the clovers, rib-grass, trefoils, poas, fescues, and some other grasses, about eight to ten varieties; sowing thickly having considerable effect in obtaining a good turf at once. Three to four hundred-weight of the best Peruvian guano is sown to the acre by hand on the young seeds in January or February, taking care to select a wet time for the sowing. One competitor, thinking to gain some advantage, after sowing the usual top-dressing repeated another of the same weight. The second dressing was given at midnight, in order to keep to himself the chance to be obtained in that way. I inspected the different pastures in the first week of June, 1856: that which had been twice dresssed with guano was decidedly of the greatest bulk, estimated to make 3 tons of hay to the acre; the rye-grass was very long, and much laid down and damaged in the bottom; there was not much clover to be seen, nor cow-grass, nor trefoil, and nearly all the finer grasses had been smothered by the great length and over luxuriance of the rye-grass. Six cwt. of the best guano, or even more, may be applied at one dressing for pasture, particularly for sheep, taking care not to allow the pasture to become too long, but to have it eaten well down.

Guano is much adulterated when in the hands of some dealers; and I have heard it asserted that earthy material is frequently put into a ship's bottom for ballast when going for a cargo of guano; that the guano is loaded on the ballast, and of course brought to this country and discharged with the guano. How far this is fact or not I cannot undertake to say; but in order to avoid fraud, a number of farmers have made joint purchase of 30 tons on shipboard, and from thence it has been removed direct to our individual establishments, and still we have occasionally found stones and other objectionable material in it. Notwithstanding that fact, the safest way for farmers is to make their purchases of guano on board the importers' ships.

Marling.—Marling now is not generally attended to for the improvement of grass lands; it is, however a lasting help to most soils, except the more tenacious kinds. Even to these a dressing of marl is advantageous. Good marl often lies some few feet below the surface: it will effervesce with an acid when exposed to the atmosphere. In frost it soon falls,

almost like lime; the same if exposed to dry weather succeeded by rain.

There is a marl called slate or stone marl, but this peculiar material is only found in districts of the red sandstone, and from 3 to 6 feet or more below the surface, and not unfrequently 2 or 3 feet of rock or red ashlar stone above it. In character and appearance it is altogether different from common marls. It has to be hacked or broken up with picks, and, when spread on the land, appears much like stone, but soon falls down by exposure. There are different colours of this stone or slate marl—red, blue, and yellow. It is very expensive to dig, but the best of it has nearly the same effect as the best bones: from 60 to 80 cube yards are laid on an acre, and of course it must be used near where it is dug. In 1846 a railway some hundred yards long was laid down to improve some moor-like land at Alvanley, near the forest of Delamere. From 50 to 60 acres were covered with stone marl, the greater part of which had scarcely any soil, nor had there ever been any attempt at cultivating it: no vegetable was growing on the surface, except dwarfish heaths. So rocky or full of stones was the surface of many acres, that it was not to be ploughed. No other substance could have worked such a change on such a surface; it is now a most beautiful and luxuriant pasture. Some years since I was on a field of 40 acres, part of a farm near the same forest: of this field 10 acres bore wheat, 10 barley, 10 oats, and 10 clover. The grain crops were just coming into ear at the time when I was over the farm, and were so long and luxuriant as in all likelihood to be lodged by the first shower of rain. I spoke to the farmer of the impolicy of having his land in that state. He said it was not done by any act of his; that the field had been under the four-course system for 20 years without any help of manure, but had been covered with slate marl about 22 years since.

On the Alvanley side of Delamere there are many fields which have been dressed with this peculiar marl, and these fields are some of the richest pastures the district affords.

Shoddy.—Woollen manufacturers, in the different processes of combing, fulling, and dressing wools, and finishing cloths made of wools, collect a material which is a powerful manure; it is mixed with the oil and grease which are used in most of the processes of woollen manufacture. The material I allude to is called shoddy. It is used with good effect on grass land, the price varying from 10*s.* to 20*s.* per ton. The very best of it was much called for in some hop-growing districts before the introduction of guano; and the manufacturers of woollens in Lancashire and Yorkshire still send some of it south for hop-gardens. Four tons per acre of the best shoddy is a good dress-

ing, and its effect is visible for several years. The cotton manufacturers, wherever they are established, produce much waste in their manufacture, particularly from coarse cottons. Vast quantities of the seeds of the cotton-plant are dressed out of the cottons, and these seeds contain much oil. Some establishments are entirely employed in cleaning coarse cottons, and perhaps produce 1200 to 1500 tons of manure in a year. If it lies together for a few days, with moisture added, it becomes quite as hot as horse-dung. Many of the seeds vegetate and grow several inches, but, of course, soon die, even in our summer. There must now be some thousands of tons of this manure made in the cotton-manufacturing districts. It is used in mixture with the soil made at the mills; but as there is much more than can be employed in that way, a great quantity is carted away, even for 8 or 10 miles, sometimes to be used as an absorbent of the liquids about a farm-yard, or in cattle-stalls, and very frequently to be spread in a dry state on grass lands. Its common price is 2*s.* to 2*s.* 6*d.* per ton, and 7 tons are a good dressing for one acre, either to pasture or to cut for hay, and its value is now so well understood that I have seen many carts waiting at one mill to get loaded.

A great extent of grass as well as tillage land is maintained in a highly-productive condition from the refuse of our manufactories, which is of course advantageous to the purely agricultural districts, by lessening the demand for bones, guano, and other more easily transportable manures.

I occupy two farms about 20 miles distant from each other, one about 100 feet above the sea level, the other at an altitude of 400 feet. I have also had the superintendence and direction of important improvements on grass lands lying at an altitude of 600 feet, and I find, from observation and experience, that every description of manure — even lime and marl — are much less lasting on high lands than on lands situated at lower altitudes, the difference beginning to be perceptible at an elevation of 250 to 300 feet.

On the high range of country where I used lime 12 years ago, I have observed that the land then limed has shown a less marked effect in the last two years. I have not found this to be the case where bones were used, but they were applied in nearly twice the quantity on a given space which has produced such decided and permanent results in lower altitudes in the same and adjoining counties.

Ashley, Altrincham, Cheshire.

XI.—*On the Manuring of Grass-Land.* By the Rev. W. R. Bowditch.

Statistics would be out of place in an article on the manuring of grass, and if they were not, the difficulty of arriving at trustworthy conclusions is so great, that I should leave to others the task of determining how much land is in grass, and what portion should be assigned to each of the classes into which it is divisible.

Mr. Caird, however, has put the matter so as to show the overwhelming importance of grass to the national agriculture, and I shall content myself with his statement to show the claim which the manuring of grass has upon landowners and farmers, and therefore upon the country at large. We cannot too often insist upon the *general* as well as the *special* interests connected with agriculture, because our town populations are not sufficiently aware that a nation's prosperity varies directly as its agriculture, and that England is pre-eminent in other respects greatly because it is pre-eminent, area for area, in the production of food for man and beast.

According to Mr. Caird, it appears that while France has 53 per cent. of its cultivated land under corn, England has but 25 per cent.; but in grass and meadow, the natural food of live-stock, England has 50 per cent. and France only 22. Notwithstanding this enormous difference, England grows $5\frac{1}{9}$ bushels of wheat to each person, and France $5\frac{1}{2}$ bushels.

Every acre of corn-land in England receives, on the average, the manure produced from three acres of grass (such are the relative proportions of land in grass and corn), while in France the manure from each acre of grass must be spread over $2\frac{1}{2}$ acres of corn-land. Or, to give a more definite view of the different systems, while that of England affords from its grass-lands the equivalent of nine loads of manure to enrich each acre of corn, that of France yields little more than one load to each acre.

This shows the relative proportion of grass (I would not be understood as producing it for any other purpose), and unfortunately it shows also the popular sentiment and practice with reference to grass. The pastures and meadows of the country are regarded as legitimate sources of plunder to the cultivator, who lavishes the spoils upon his petted tillage lands. This should not be. It is bad for the landowner, because it renders half his land worth very much less than it ought to be and easily might be; it is bad for the farmer, because it saddles him with a large

breadth of land which does little more than just pay out-of-pocket expenses; and it is especially bad for the country at large, who are obliged to expend enormous sums of money with the foreigner for meat and wool, which, under a better system, might be spent upon their neighbours at home, and thus find its way ultimately back to the pockets of those who first laid it out. I shall be pardoned for asking earnest consideration of the following figures, and the exportation of money which they denote, and then inquiring whether half the land of the country should be left as it is almost to nature.

In 1855-6 we imported for food the following enormous quantities of animal produce:—

	1855.		1856.
Oxen and bulls	63,687	.. ..	52,019
Cows	10,063	.. ..	9,843
Calves	23,777	.. ..	21,444
Sheep	156,646	.. ..	135,588
Lambs	5,996	.. ..	9,471
Pigs	12,171	.. ..	9,916
Total animals	272,340	.. ..	238,281

	Cwt.		Cwt.
Bacon and hams	241,494	.. ..	372,795
Beef	230,755	.. ..	187,837
Pork	204,326	.. ..	156,266
Butter	447,266	.. ..	514,764
Cheese	384,192	.. ..	407,076
Lard	118,109	.. ..	136,650
Total cwt. ..	1,626,142	.. ..	1,775,388
Eggs	99,732,800	.. ..	117,419,800
Poultry, worth	£42,073	.. ..	£48,230

In addition to these quantities of food we imported wool for our clothing:—

	1855.		1856.
Wool, Sheep and Lambs'.	lbs.		lbs.
British Colonies	74,613,223	.. ..	81,893,148
Foreign	23,240,516	.. ..	31,343,751
	97,853,739	.. ..	113,236,890

Hides and several other things might have been added; but I do not wish to overlay the argument with details. I wish it to be seen that our production of articles of food and clothing derived from grass is very far below the demand, that the grass is capable

of producing very much, perhaps all, of what is now imported, and therefore that the energy, skill, and capital which have made our arable lands the most productive in the world, ought to be applied to grass, and to render that the compeer of the other.

To prevent misunderstanding, it may be well to add that I do not contemplate the abstraction of any of the manure now laid upon the arable land, but an annual dressing of the grass *in addition to what is now given to land in tillage.*

We shall facilitate our progress if we endeavour to realize what is removed per acre from land in grass before attempting to consider the best mode of supplying the loss, and, if possible, of increasing the productive powers of nearly half the land of the kingdom.

Ordinary meadow, with fair management, will produce a ton and a half of hay per acre at the first mowing, and a ton per acre at the second mowing, and I shall assume this as the average of production throughout. It is not meant, of course, that this quantity is *now* produced, but that as this is a fair average for land in a moderately good state of management, so it might be generally the average were grass treated as it should be.

The ash of hay varies greatly: it is said by Johnston to be from 50 to 100 lbs. per 1000 lbs. of hay in its ordinary state of dryness. Taking the mean of these, 75 lbs., we find that the crop of grass above mentioned carries from each acre 420 lbs. of incombustible matter, which remains as ash when the hay is burned. Have farmers generally a correct notion of this, or even any notion at all? Do they bestow upon it the thought it deserves and must have if they desire to bring their land to a maximum of productiveness? Were it thought about, we should never read such disclosures as we do in the county reports in this Journal. Bearing in mind that five yearly crops of grass remove from an acre nearly a ton of mineral matter, which must be restored if the land is to retain its productiveness (grass-land never knows a fallow or the disintegrating effects of stirrings which expose it to the atmosphere), we may inquire the composition of that which is taken away. The following analyses of the ash will show its composition sufficiently nearly for practical purpose, though they are not to be taken as accurate representatives of every kind of grass in every place. To exemplify possible differences, I subjoin a very remarkable analysis, in which *soda* in hay is to *potash* as 16 to 12·5. Taken as approximative merely, they show practical farmers what they remove from the land in a good crop of hay and aftergrass, and what they must restore to it if they wish their land to be kept in heart:—

	Meadow Hay. Boussingault.		Rye Grass. Thompson.
Potash	18·11	29·03	8·03
Soda	1·35	2·44	2·17
Lime	22·95	16·36	6·50
Magnesia	6·75	8·82	4·01
Oxide of iron, alumina, &c.	1·69	0·64	0·36
Phosphoric acid	5·97	5·63	12·51
Sulphuric acid	2·70	3·08	..
Chlorine	2·59	2·97	..
Silica	37·89	31·03	64·57
	100·00	100·00	98·15

The following analysis is by M. Isidore Pierre, translated in the 'Chemist,' August, 1857, from 'Comptes Rendus.' This hay gave 69·011 grammes of ash per kilogramme :—

	Grammes.
Silica	19·406
Phosphoric acid	4·440
Lime	12·637
Magnesia	1·824
Soda	15·956
Potassa	12·527
	66·790

These figures will be conclusive. No thoughtful reader will require one word of argument to prove that he must supply his grass-land with minerals if he intend it to produce the crops which it is capable of yielding. It should also be borne in mind that ·75 per cent. of ash is probably below the average, and that in some cases this quantity is doubled. I have myself recently burnt a sample of hay sent to me from London which left 1·5 per cent. of ash, and it was not artificially dried in the laboratory.

But the case is only half stated. We must make the same inquiry relative to nitrogen which we have made relative to minerals. What quantity of this is removed annually from each acre which produces the crop I have supposed?

The nitrogen in hay varies, and hence different chemists give different estimates of its quantity. I subjoin three, and the lowest of them is calculated to make the farmer think—may I not say when added to what precedes, to make him reform his practice?

Boussingault estimates the nitrogen of hay at 1·15 per cent., according to which we shall take from each acre of land per year 64·4 lbs., corresponding to 119·6 lbs. of ammonia.*

* By ammonia here is signified the oxide of ammonium, NH_4O, the compound intended by that name when we speak of sulphate $NH_4O, SO_3 + HO$, nitrate NH_4O, NO_5, or carbonate $2NH_4O, 3CO_2$ of ammonia. They who wish can easily alter the figures to suit the formula NH_3.

Stockhardt,* generalizing what was known up to the time of his writing, estimates the nitrogen of hay at 1·4 per cent. of *dry* meadow grass (hay and aftermath). Taking Boussingault's estimate of the water in hay, 11 per cent., and deducting 616 lbs. from 5600 lbs., we have 4984 lbs. as the crop of dry hay. The nitrogen in this is 69·77 lbs., corresponding to 129·5 lbs. of ammonia.

Liebig says,† "According to the best analyses, it may be assumed that meadow hay contains 1 per cent. of nitrogen, consequently 100 parts of nitrogen are contained in 100,000 parts of hay." All his calculations are made upon this basis. Upon this assumption our grass-crop removes 56 lbs. of nitrogen, corresponding to 104 lbs. of ammonia.

Liebig has applied this subject so well, that I shall take advantage of his words:—

"From a given surface of land we reap, in different cultivated crops, according to the analyses which have been made, very unequal quantities of nitrogen. If we assume that the amount of nitrogen, reaped from an acre of land in the form of grain and straw, is in the case of rye represented by 100 parts by weight, then the same surface, one acre, yields of nitrogen,—

In Oats	114 parts.
Barley	116 ,,
Wheat	118 ,,
Meadow hay	121 ,, ."‡

Farmers ought to reflect very seriously upon this statement. Their hay-crop removes from their land (and of course requires for growth) more nitrogen than rye, oats, barley, or wheat, upon which they bestow their ammoniacal compounds with an abundant and ungrudging hand. It is surely worth while—nay, it is a duty to themselves, their landlords, and their country—to deal with grass as they have dealt and are dealing with corn. The return will not be found inferior.

Having thus realized what is required, we may proceed to inquire into its sources of supply—the soil and manure.

A very general impression among farmers is, that the fine, dark, stoneless soil found immediately below turf is formed by the decay of roots and grass plants which have died, and that this forms a manure-bed in which future crops may flourish. If this were so, it is nearly impossible to imagine the enormous crops which must of necessity be produced upon every acre of grass which grew upon a stratum of matter thus formed, but a single inch in thickness. We receive it as a principle in agriculture, that the remains of a crop produced by decay form the best

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* 'Chemistry of Agriculture,' by Henfrey, 1855, p. 292.

† Royal Agricultural Society's Journal, vol. xvii., p. 300.

‡ See also Table from Stockhart, p. 239.

manure for a crop of the same description; and if the fine mould of our grass fields were really due to decayed grass, it would be a mine of wealth to the fortunate possessor. Any one may convince himself that the mould of his pastures and meadows cannot have this origin by taking a quantity of hay, or even thin sods, and when they are rotten applying them a single inch thick upon part of a field which possesses a good depth of black mould beneath the sward. The crop produced by this application will assure him that the layer of similar-looking material which lies above the true soil of his grass fields has a different origin. He may arrive at the same conclusion by another process. Take a high estimate of the yearly quantity of roots, &c., left in the soil by grass, and we shall see that it is wholly inadequate to form the thick dark layer of which we are seeking the origin.

"When the young grass throws up its leaves into the air, from which it derives so much of its nourishment, it throws down its roots into the soil in quest of food of another kind. The leaves may be mown or cropped by animals, and carried off the field; but the roots remain in the soil, and as they die, gradually fill its upper part with vegetable matter. On an average the *annual* production of roots on old grass land is equal to one third, or one fourth the weight of hay, though no doubt it varies much, both with the kind of grass and with the kind of soil. When wheat is cut down the quantity of straw left in the field, in the form of stubble and roots, is sometimes greater than the quantity carried off in the sheaf. Upon a grass field two or three tons of hay may be reaped from an acre, and therefore from half a ton to a ton of dry roots is annually produced and left in the soil. If anything like this weight of roots die every year in land kept in pasture, we can readily understand how the vegetable matter should gradually accumulate."*

We will take the largest quantity here mentioned, viz., a ton per year per acre, and assume, that when the fibre was destroyed so as to form a dark-coloured mould it still weighed a ton, and then apply it to an acre of land and appreciate the thickness of the layer formed by it! Now I happen to have seen many acres dressed with a ton each of material, rather denser than this certainly, but still sufficiently near to afford a good criterion. I have taken strangers into the fields to which the dressing was applied and they have sought amongst the grass to find it; but, in every case I can remember, they have sought in vain. By careful scrutiny I have found particles, but sometimes have sought for some time in vain. Add to this the fact, that the decayed roots of one year would be largely consumed to supply the grass of the next year's growth, and I think no one will contend that they alone could possibly form the dark layer familiar to every one who has cut through the turf of old pastures, especially of such

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* Johnston, Elements of Agricultural Chemistry, p. 151, fifth edition.

as rest upon clay. That roots do die annually and form valuable fertilizing matter for subsequent growth is indubitable, and I only contend that they do not do this in such quantity as to supersede the use of manure, which they would do if they really formed the thick layer of (so-called) vegetable soil found in fields of old grass.

Whence then can we derive the fine surface-mould, so different in physical characters from the original soil of the field in which it is found? Mr. Darwin's explanation in a paper on mould appears both clear and conclusive :—

"The author commences by observing two of the most striking characters by which the superficial layer of earth, or, as it is commonly called, vegetable mould, is distinguished. These are its nearly homogeneous nature, although overlying different kinds of subsoil, and the uniform fineness of its *particles*. The latter fact may be well observed in any gravelly country, where, although in a ploughed field, a large proportion of the soil consists of small stones; yet in old pasture land not a single pebble will be found within some inches of the surface. The author's attention was called to this subject by Mr. Wedgwood, of Maer Hall in Staffordshire, who showed him several fields, some of which a few years before had been covered with lime, and others with burnt marl and cinders. These substances in every case are now buried to the depth of some inches beneath the turf. Three fields were examined with care: the first consisted of good pasture-land which had been limed without having been ploughed, about twelve years and a half before; the turf was about half an inch thick, and two inches and a half beneath it was a layer or row of small aggregated lumps of the lime, forming at an equal depth a well-marked white line. The soil beneath this was of a gravelly nature, and differed very considerably from the mould nearer the surface. About three years since, cinders were likewise spread on this field; these are now buried at the depth of an inch, forming a line of black spots parallel to and above the white layer of lime. Some other cinders which had been scattered in another part of the same field, were either still lying on the surface or entangled in the roots of the grass. The second field examined was remarkable only from the cinders being now buried in a layer nearly an inch thick, three inches beneath the surface. This layer was in parts so continuous that the superficial mould was only attached to the subsoil of red clay by the longer roots of the grass.

"The history of the third field is more complete. Previously to fifteen years since it was waste land, but at that time it was drained, harrowed, ploughed, and well covered with burnt marl and cinders. It has not since been disturbed, and now supports a tolerably good pasture. The section here was turf half an inch, mould two inches and a half, a layer one and a half thick, composed of fragments of burnt marl (conspicuous from their bright red colour and some of considerable size, viz., an inch by half an inch broad and a quarter thick), of cinders and a few quartz pebbles mingled with earth; lastly, about four inches and a half beneath the surface was the original black peaty soil. Thus beneath a layer (nearly four inches thick) of fine particles of earth mixed with some vegetable matter, those substances now occurred, which fifteen years before had been spread on the surface. Mr. Darwin stated that the appearance in all cases was as if the fragments had, as the farmers believe, worked themselves down. It does not, however, appear at all possible that either the powdered lime or the fragments of burnt marl and the pebbles could sink through compact earth to some inches beneath the surface, and still remain in a continuous layer; nor is it probable that the decay of the grass, although adding to the surface some of the constituent parts of the mould, should separate in so short a time the fine from the coarse earth, and accumulate the former on those objects which so lately were strewed on the surface. Mr. Darwin also remarked, that near

towns, in fields which did not appear to have been ploughed, he had often been surprised by finding pieces of pottery and bones some inches below the turf. On the mountains of Chile he had been perplexed by noticing elevated marine shells covered by earth, in situations where rain could not have washed it on them.

"The explanation of these circumstances which occurred to Mr. Wedgwood, although it may at first appear trivial, the author does not doubt is the correct one, viz., that the whole is due to the digestive process by which the common earthworm is supported. On carefully examining between the blades of grass in the fields above described, the author found that there was scarcely a space of two inches square without a little heap of the cylindrical castings of worms. It is well known that worms swallow earthy matter, and that, having separated the serviceable portion, they eject at the mouth of their burrows the remainder in little intestine-shaped heaps. The worm is unable to swallow coarse particles; and as it would naturally avoid pure lime, the fine earth lying beneath either the cinders and burnt marl, or the powdered lime, would by a slow process be removed and thrown up to the surface. This supposition is not imaginary, for in the field in which the cinders had been spread out only half a year before, Mr. Darwin actually saw the castings of the worms heaped on the smaller fragments. Nor is the agency so trivial as it at first might be thought, the great number of earthworms (as every one must be aware who has ever dug in a grass field) making up for the insignificant quantity of work which each performs."*

Johnston quotes from the Carlisle Journal an instance illustrative of the quantity of worms in grass land. A bowling-green at Penrith (45 yards by 32) was watered with a solution of corrosive sublimate, after which *eleven stones* of worms were gathered, and four years before *twenty stones.* Here is a cause adequate to the effect produced.

To determine how far decomposed grass really contributes to the fine soil of pastures, I made the following experiment:—

Two samples of soil were taken from Heath Common, opposite Heath Hall, the residence of Colonel Smyth, M.P., the one at the depth of three-quarters of an inch, and the other at the depth of three and a half inches. Both specimens contained a good many roots of growing grass, but that taken nearest the turf contained considerably more than the other. Both samples were carefully dried for the same time at the same temperature, not exceeding 200° Fahr.; and after having the larger roots picked out, both were burnt with the usual precautions and weighed. The sample taken at three-quarters of an inch lost 10·6 per cent., while the sample from a depth of three and a half inches lost but 9·5 per cent., showing 1·1 per cent. more organic matter in that which was taken near the turf. It seemed unnecessary to make another experiment to dispose of the notion of "vegetable soil" beneath meadows and pastures. Here is a plot of land which has probably never been wrought by man, but has laid in a state of grass or other natural crop ever since the Deluge. It bears a short, green, nutritious pasture upon which cattle are reported to

* 'Penny Cyclopædia,' art. "Lumbricus."

thrive well; and yet 100 lbs. of it taken close to the turf, and 100 lbs. taken at a depth which appeared natural soil, with a few roots in it, differ by but one pound and a tenth of organic matter.

The common consists of useful turnip soil upon the sandstone of the coal-measures.

That worms are the agents which produce this fine earth in our grass-fields, is put beyond question by an instance in which their operations are unusually evident. Some years ago a gentleman near Thirsk, in Yorkshire, is said to have introduced from the Continent a worm unknown in England, having a blue head and far exceeding in size the largest dew-worms. At first the worms were confined to a small plot upon his own estate, but now their operations may be traced in three different properties over more than 200 acres. One of the gentlemen, Mr. Pecket, of Carlton Husthwaite, who is troubled with them—for they are regarded as a plague—informs me that it is no unfrequent occurrence *to sink up to the ankle in wormcasts in a grass-field.* He says that the casts are often four inches high, and that they are quite as great a nuisance as moles. Indeed their labours are as evident upon the surface as those of that animal. I have not yet had an opportunity to go and examine the subject, but hope to do so and to publish the result.

Meanwhile Mr. Pecket has obligingly sent me some sections of turf and soil, and one of these strikingly corroborates Mr. Darwin's account of what he saw in Staffordshire. The section was taken from a field in which the worm labours have ceased, and was labelled "no worm for many years." Just under the sod and parallel with it was a layer of coal-ashes, as they are generally called, but, in reality, fine cinders. This layer was almost continuous, and was probably the cause of the worms ultimately forsaking the field, owing to the difficulty of ascending and descending. I burnt a sample of this (after picking out all the larger fragments), taken from the depth of an inch, and found it to contain 14·8 per cent. of combustible matter, chiefly, of course, fine cinders. A portion from the same section taken four inches below the surface contained but 4·2 per cent.

This dressing with fine cinders must certainly be condemned on grass, for being almost indestructible they must impede the action of the grass roots and the culture of the land by insects. Soot may be objected to upon the same principle. Its large proportion of carbon must remain for many ages a useless encumbrance to the soil, and it therefore appears prudent to use it cautiously, and with considerable intervals between the applications.

In this instance the effects are noticed simply because the larger size of the agents renders their labours more easily observable, but it is manifest that what takes place here may be found everywhere else if properly sought, and that all the differ-

ence between the actions of worms is *a difference of degree.* The smaller species act in the same manner as the larger, only longer time and more minute observation are necessary to form a proper judgment of their labours.

By the way, is not this nature's provision for the aëration of the soil of grass-land, which cannot be stirred by man? Are not worms her ploughmen, bringing fresh soil to the surface for atmospheric disintegration, and opening channels in the earth to promote decomposition there? May not the earth-food of grass plants depend principally upon the labours of earthworms?

I have dwelt upon this point for the purpose of showing the farmer that he must not rely upon the supposed fertility of "vegetable mould" beneath his grass, because that vegetable mould does not exist, but must recollect that grass grows essentially *in the soil of the farm*, whatever that may be, and therefore needs manure as much as roots or grain. Grass requires earth of extreme fineness for its highest development, and Providence has taken care that this shall be provided by the unceasing labours of the millions of insects which have their habitations beneath its shelter. They are the agents appointed to bring about a *mechanical* condition of the soil which is beyond the power of man, but which is needed for a full supply of the natural food of cattle. But they can do no more. Earthworms and other insects cannot alter the chemical constitution of the soil which they derive from below and deposit upon the surface; but whatever need existed in the original soil exists also in that which they have reduced to the finest mechanical condition with which we are acquainted. They prepare for fertilisation, but they do not fertilise; and when nature, by other agents, has performed her part, man must perform his if he desire to obtain such crops as are indispensable in a condition of high civilisation and dense population. Insects and the atmosphere are able to clothe the earth in a robe of green, and supply the means of healthy subsistence to the few animals which exist in a state of nature, but wool for clothing, and meat for feeding the masses which progress brings together, must result from a liberal supply of the elements of growth dispensed by the hand of Him who has undertaken the important task of provisioning the nation. "Whoso will reap must sow," applies to grass as well as grain.

Time of Manuring.

Where grass is manured the season of its application is too much matter of caprice or ignorant prejudice, and yet surely nature indicates the proper time to apply it, and the best practice shows the wisdom of attending to her teachings. The object of manuring is the growth of the largest possible quantity of grass upon a given area. This will be effected by causing growth

during the *whole season of growth*, and any loss of time in this case is loss of quantity. Early growth is secured by having all the elements of nutrition thoroughly incorporated with the soil amongst the roots of the grasses, in such a state of decomposition that they can be taken up by the roots as soon as the temperature of the earth and the air stimulate the plants into activity. That this occurs *very early* is certain, for by the following table we perceive that many of the grasses reach maturity in May, and most of them before the middle of June, and therefore we may safely assume that the manure should be well incorporated with the soil (not lying upon its surface), and sufficiently decomposed there to act efficiently *in the middle of March.* But what does this involve? It involves no less than the change of the solid and insoluble matters applied as manure into soluble salts and gases, and the removal of these from the surface by water into the soil and into contact with the grass roots, which absorb and use them as they have need. This is not the work of a day, nor a week, nor a month even, but probably not less than two or three months are required to bring manures of moderate solubility into contact with the absorbents of the roots in the state in which they can be taken up. And when the manure contains much unreduced fibre, or is not readily soluble, it cannot be applied too early in autumn or winter, if it be intended to promote and sustain growth during the *whole* of the following season.

Two other considerations lead us to the same conclusion. Vegetable physiologists and good gardeners agree that trees should be transplanted as early as possible, that *they may make root during winter, and be ready for a good start in spring.* The market-gardener plants his cabbages at the first opportunity, well knowing that the roots made in autumn and winter are indispensable to early growth in spring. If we take up the newly planted tree or cabbage-plant in February, we shall find that it has been constantly active, and has made a large quantity of new roots, although no token of activity has been visible above ground. It has not *grown* in the common sense of the word, but it has *prepared to grow* directly light and heat sufficient are furnished by the sun. Is it not probable that the same root growth takes place in the grass-field, though we behold no outward token of it, and that in favourable circumstances the grass has made ready for its spring start as well as the bush or the cabbage? And if so, is it not further probable that when the stimuli of growth, light, and heat, are comparatively absent, this root formation is much facilitated and furthered by having at hand, in assimilable compounds, the materials of nutrition? The Middlesex hay-farmer thinks so, for he supplies his already rich land with fresh elements of fertility in October or November, and even though it should be proved that he is not acquainted with

the reason of his practice, I should claim that practice as the best of evidence in favour of the teachings of science. But the Middlesex hay-farmer is not alone. Mr. Horsfall applies his cowdung as soon as ever his land is clear and the weather is favourable, and even testifies to the advantage of applying guano in November. He writes:—

"In addition to this yearly dressing with excrement, I apply guano at the rate of 2 cwt. to each acre. I do this usually in the spring. I have, however, thought that I derived equal, if not greater, benefit from its application in very wet weather in November. The growth during March was sensibly greater than on adjacent land on which the guano was not applied till April, and the main crop of hay was certainly not less than on that dressed in April."

A gentleman from Ireland writes me:—

"My experience as to the time of application exactly coincides with Mr. Horsfall's, that December is better than February for guano and superphosphate. Almost all the manures I have tried in top-dressing pasture land, as guano, superphosphate, and even saline manures, when applied in spring did not show their full effect until the autumn, whereas those applied in early winter seemed to come into operation with the first burst of spring, and to be much more effectual."

Another consideration tending to the same point, is the necessity for early mowing, in order to obtain the largest crop of the most nutritious and best-got hay. The superiority of June over July for haymaking is unquestionable, and was well illustrated last year in this neighbourhood. They who cut their hay in the middle of June had it made, almost as fast as it could be cut, by the hot dry weather which then prevailed. Hay secured before the 27th of June was got without a drop of rain. On the contrary, that which was left unmown till the first or second week in July was in the field for a fortnight or three weeks, was much injured by the rain, and cost three or four times as much making as the other. I know two instances of this upon lands situated within half a mile of each other of about the same quality, and yielding about the same crop. One almost made itself; the other was turned, cocked, drenched with rain, opened, and re-cocked, until the workpeople were tired of their occupation, and yet both crops were manured with the same manure, applied in the latter case about the beginning of March, in the former at Christmas. When the hay was carried in one case, the other had produced a good aftermath.

By general consent the greatest weight of the most nutritious hay is secured by mowing when the grasses are in flower. The plants at that time have the largest quantity of nourishment, and the smallest quantity of woody fibre, which is consistent with an adequate crop. The large variety of grasses in every pasture or meadow assures us that the flowering season will vary; that one class may have shed its seed while another is flowering, and a

third has not yet attained maturity. The only plan in such a case is to learn the times when the several classes flower, and to select that for mowing which agrees best with the proper season of the largest number. I have compiled the following table as a guide to determine this point, and it seems to indicate pretty plainly that from the middle to the end of June (say from the 15th to the 25th) is the best time to mow. Then, under ordinary circumstances, the most grasses will be in the desired stage of growth. Upon rich land where manure is applied early, this readiness for the scythe will be some eight or ten days earlier.

I know how easy it is to doubt or deny, and how certainly doubt, or denial, or both, will be the portion of him who asks some small deviation from existing routine, even though that deviation have no other object than the good of those whom he addresses. I expect the counsel to manure early will be voted a bore by most rule-of-thumb farmers, and by them be left to perish of neglect. The thoughtful and observant alone will receive the counsel as it is offered, and employ it for their advantage. I trust the following extract will be to the agricultural conscience as the ghost of the murdered to the murderer. May every spoilt haystack evoke the sprite each time its owner sees it, until at length repentance induce amendment, and no ruined hay remain to call up the tormentor!

"Analytical Researches on Hay Tea, and on some of the alterations which take place in Hay from Natural Meadows, when treated either with hot or cold water. By M. Isidore Pierre.—*Comptes Rendus.* Translated in 'The Chemist,' September, 1857.

"Treatment of hay by displacement, without heat. 8450 grammes of hay were put into a large displacement apparatus, and infused for twelve hours in distilled water at a temperature of 68° to 77° Fahr. The water was then suffered to run off, and the hay was pressed. This treatment was repeated several times, until the water came from the apparatus limpid and colourless.

"By evaporation *in vacuo*, the water when united gave 1400 grammes of extract, or 16·57 per cent. of the weight of the hay taken in the normal state. After this operation the hay appeared much whiter than that which had been operated upon by hot water [referring to a previous experiment, which does not bear upon the injury done to hay by rain], and *I can only compare it to the effect produced upon the outside of an uncovered haystack after long rains, without having undergone any other apparent damage than this repeated washing in the open air.*

"Its nitrogen was reduced to 11·1 per cent. [It originally contained 13·9 grains of nitrogen per kilogramme.]

"Under the influence of this treatment with cold water, the hay had lost in the first place 3·5 grains of nitrogen per kilogramme, or 20 per cent., without reckoning its loss of weight; the combination of the two losses brings to 36·5 per cent. the diminution of the proportion of nitrogen originally contained in the hay.

"*This enormous loss will give us an idea of the kind of damage which is done to hay by the influence of rain alone, and that without its taking any unpleasant taste or contracting any bad odour.*

"The dry extract given by this operation was very similar to that obtained by the previous operation [in which heat was employed], and its amount of nitrogen was 17·3 grammes per kilogramme, which differs but little from the extract produced by infusions with heat.

"After having ascertained the amount of nitrogen in these various substances, I endeavoured to ascertain what modifications there might have been produced in the constitution of the hay, under the influence of these various treatments. I shall at present only mention the most important mineral principles, silica, phosphoric acid, lime, magnesia, soda, and potassa.

	Normal Hay, per kilo.	Treated with heat, per kilo.	Treated cold, per kilo.
	Gr.	Gr.	Gr.
Ash	69·011	39·591	35·155
Silica	19·406	20·363	23·155
Phosphoric acid	4·440	2·756	1·329
Lime	12·637	9·359	8·681
Magnesia	1·824	1·004	0·386
Soda	15·956	3·931	1·153
Potassa	12·527	0·900	1·395

"We see immediately from these numbers that the loss has been chiefly in the potassa and soda, rather less in the phosphoric acid, and a little less again in the lime and magnesia.

"Hay may thus lose nine-tenths of the potassa, almost the same of soda [these alkalies are indispensable to the formation of flesh and blood], from half to three-quarters of its phosphoric acid, from a third to a quarter of the lime. The apparent augmentation of the silica does not prove that the hay has not, under the influence of water, lost a certain quantity of this substance, for we shall very shortly see the contrary by the presence of silica in the ash of the extract; this apparent augmentation combined with the real diminution of the weight of the hay, is changed into a loss, comprised between 5 and 12 per cent. of the silica in the original hay.

"The comparison of the ash of the extracts with that of the original hay, shows us, in a completely soluble state, the mineral principles removed from the hay by these different treatments.

	Normal Hay.	Extract with heat.	Extract without heat.
	Gr.	Gr.	Gr.
Ash	69·011	199·402	242·438
Silica	19·406	18·118	9·180
Phosphoric acid	4·440	13·563	16·261
Lime	12·637	24·557	37·199

That is to say, that extract of hay may contain, in the state of soluble compounds, from 9 to 18 thousandths of its weight of silica, from 13·5 to 16 thousandths of phosphoric acid, in the state of phosphate, and from 25 to 36 grammes of lime per kilogramme of extract.

"What is called *hay tea* appears, therefore, to form a very rational drink, which, independently of its aromatic, tonic, and stimulant properties, offers to young animals, under a form which pleases them, a food which is rich in nitrogenous principles, and containing, moreover, in very considerable proportions, the principles necessary for the development of their bony structure.

"Another consequence which appears to me to result from this work, is, *that under the influence of rain, even when uninjured by any fermentation, hay must lose a considerable proportion of the organic and mineral principles which are necessary to render it a good aliment. We have just seen that water alone removes from it more than a third of the nitrogenous matters which it contains.*"

The connexion of this with manuring is obvious. Late manuring compels us to wait until July for a crop, and we thus have but that season wherein to mow, and if that be wet we must submit to all its baneful influences. Early manuring, on the contrary, pushes forward the crop and leaves us a choice of three weeks or a month more, during which an attentive farmer in the average of seasons will always find a favourable week to get his hay without rain. One process enables the farmer to direct his operations; the other makes him and his work the sport of chance. It is not necessary to state which ought to be preferred.

	Mean Rainfall at Greenwich for 25 years. Inches.	Number of Rainy Days.
In May	2·01	15·8
June	1·91	11·8
July	2·41	16·1

The following are strongly recommended as the best meadow and pasture grasses, and are now sown by the best cultivators when improving old or laying down new grass. I omit the botanical names and characters, that attention may be fixed upon the one point, *their time of flowering*:—

	Flower in			
	April.	May.	June.	July.
Sweet Vernal-grass	1	..	..	..
Bent grass	..	1	..	..
Meadow Foxtail..	..	1	..	..
Jointed Foxtail	..	1	..	..
Golden Oat-grass	..	1	..	..
Round-headed Cocksfoot	..	1	..	..
Sand Fescue-grass	..	1	..	..
Sheep's Fescue-grass	..	1	..	..
Giant Cocksfoot	..	1	..	..
Crested Dogstail	..	..	1	..
Tall Fescue	..	..	1	..
Various-leaved Fescue	..	..	1	..
Hard Fescue	..	..	1	..
Catstail or Timothy	..	..	1	..
Smooth-stalked Meadow-grass	..	..	1	..
Rough-stalked Meadow-grass	..	..	1	..
Giant Fescue	..	..	1	..
Fertile Meadow-grass	..	..	1	..
Nerved-seed Meadow-grass	..	..	1	..
Meadow Fescue	..	..	1	..
Woolly Soft-grass	..	..	..	1
Total	1	8	11	1

This table proves distinctly that we are not able to lengthen the period of growth without a material sacrifice of quality, and

that if we intend to have our crop of the most value, we must grow it by the middle of June. Does not this also plead for an early application of manure? Can long dung, applied as we see it often in March and even in April, be washed in and decomposed and taken up so as to grow a crop by the middle of June? Would it not be far more likely to accomplish its object if applied between November and January? Theory assures me that it would, and the best practice shows that theory is right. The grass-land of Middlesex is probably the best managed in the world, and the early manuring and early mowing of the present day must be familiar to all observant persons who have lived in or travelled to London through the county. This practice is no novelty. It existed fifty years ago, and is described by Middleton:—

> "After the hay has been removed from the meadows, some of the farmers of this county study the state of the atmosphere, and if appearances indicate approaching rain, they lay on some of the land from which the hay has just been carried, the dung of neat cattle and such other manure as happens to be reduced so much as to admit of being spread with a shovel, and no other. On the contrary, when the barometer does not bespeak, with some degree of certainty, a pretty heavy fall of rain, the decomposed manure, as well as all the rest, is allowed to remain in the dunghills till the end of September, at which time it is applied, while the soil is sufficiently dry to bear the drawing of loaded carts without injury, and when the heat of the day is so moderated as not to exhale the volatile parts of the dung." *

The first crop of hay for cows, he says, is usually mown early in May, that for horses three or four weeks later.† Mr. Horsfall applies his manure "as soon as the ground is clear," which I suppose will be early in December, "and mows in a cold late district from the 20th to the 30th of June." ‡

Having mentioned, perhaps I ought to express an opinion upon, this summer manuring. My conviction is that it should be avoided very carefully, as being but little better than wasting manure. Rather than apply manure (unless liquid) in summer, I would sustain the loss incurred by keeping, and apply it after the stock were removed in autumn. It is remarkable that in late districts, where the hay-crop is generally a miserable one and not mown till far into July, the application of a sprinkling of dung after mowing is not uncommon. Where this is the case, I have observed a dwarfing of the grasses as compared with neighbouring fields of the same quality, but manured in winter; and in one case I recollect applying a special manure with my own hands in July in an important experiment, and I there observed a dwarfing of the grass, which remains until this day. The same manure, applied to parts of the same plot in early spring, produced considerable luxuriance.

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* 'View of the Agriculture of Middlesex.' 2nd edit., p. 286.
† P. 288.
‡ Royal Agricultural Society's Journal, vol. xviii. pp. 181-2.

My opportunities for reliable observations have been too limited to enable me to affirm positively that this result uniformly attends a summer application of manure; but the cases with which I am familiar leave little doubt on my mind that the result is a general one.*

Of course this objection, if well-founded, does not apply to liquid manuring in summer. Where liquid manure is at command, every farmer will do well to remember the advice of the Cheshire patriarch to his young disciple, "put it on all the year round."

The following admirable remarks may well close this part of the subject:—

"In the neighbourhood of large towns there are many meadows, which, without being irrigated, are mown every year, and only fed between hay-harvest and the next spring. These require frequent manuring to keep them in heart, and, with this assistance, they produce great crops of hay every year. The management of this grass-land is well understood in Middlesex. Sometimes the meadows are manured with stable-dung, which has been laid in a heap for some time and been turned over to rot it equally. This is put on soon after the hay is cut, and the rains of July wash the dung into the ground; but if a very dry and hot summer follows, little benefit is produced by the dung, which is dried up and most of the juices evaporated. A better method is to make a compost with earth and dung, and, where it can be easily obtained, with chalk, or the old mortar of buildings pulled down. *It is spread over the land in winter*, and in spring a bush-harrow is drawn over the meadow, and it is rolled with a heavy roller. All this compost is soon washed into the ground, and invigorates the roots of the grass. *It is better to put on a slight coating of this compost every year than to give a greater portion of manure every three or four years, as is the practice of some farmers.*"

A strong objection against early manuring exists in the minds of the majority, and though it is really nothing more than an ignorant prejudice, it will never be removed unless *shown* to be wrong. The objection can be heard in almost every assemblage of farmers in the kingdom. I refer to the statement, "the manure will be washed out of the land if put on too soon"—"too soon" meaning before the time at which the plants require it, as evidenced by their appearance above-ground.

Most permanent grass is on strong land, and therefore the following experiment of Mr. Thompson is a conclusive answer to the objection in almost all cases:—

"Experiment 4.—A strong clay soil. The apparent influence of lime in aiding the decomposition of the salts of ammonia was borne in mind when selecting a specimen of strong clay, and the one here experimented on had been in grass for a great length of time, and not limed within the memory of man.

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* I quite agree with the author as to the importance of early mowing, and consequently of early manuring; but I cannot concur in his views on summer manuring, as, after numerous trials, I am convinced that on strong land the *best* time for applying farmyard manure to grass is *immediately* after the hay is off the ground. The land will then bear carting over without injury, and the rapid growth of the after-grass soon protects the manure from the sun and wind.—H. S. Thompson.

"The difficulty of getting any quantity of liquid to filter through a really strong clay is such, that though eight ounces of water were poured into the percolators, nearly three weeks elapsed before three ounces had passed through, and this quantity was, therefore, experimented on. The result was as follows:—

	In water which had filtered through.
10 grs. of sulphate of ammonia added to A ..	1 gr. sulphate of lime. 0·5 organic matter. Trace of ammonia.
10 grs. sesquicarbonate of ammonia in B ..	0·5 organic matter. Trace of ammonia.

The very small quantity of mineral substances obtained from the water filtered through clay was so remarkable, as in the first instance to cause the result to be unrecorded, on the supposition that some accidental circumstance must have occurred to vitiate the experiment, and it was repeated with every attention and care. The result is given above.

"My main object in making these experiments had now been attained, and I had convinced myself that either sandy, clayey, or black vegetable soils, possessed the power of retaining a much larger amount of ammoniacal salts than they receive in the most liberal manuring.

"The weight of the column of soil operated on (8 inches deep) was 2 lbs., and to this 10 grs. of carbonate or sulphate of ammonia were added, which is equivalent to an application of 18½ cwt. per acre!"*

The following composts may assist in showing how grass may be dressed without fold dung. Near towns where dung can be purchased, it may be used:—

	£.	s.	d.
Manure, 3 tons, at 5*s*.	0	15	0
Cartage, per ton 2*s*. 6*d*.	0	7	6
Earth cartage, 3 tons, at 1*s*.	0	3	0
Common salt, 1 cwt., at 1*s*.	0	1	0
Mixing, at 3*d*. per ton	0	1	6
Turning, at 3*d*.	0	1	6
Watering with liquid manure twice, say ..	0	2	0
Cartage and spreading, at 1*s*.	0	6	0
	£1	17	6

Where shoddy can be obtained but manure cannot:—

	£.	s.	d.
Shoddy, 1 ton, at 20*s*.	1	0	0
Earth, 3 tons, at 1*s*.	0	3	0
Bone-ash, 1 cwt., at 5*s*.	0	5	0
Common salt, 1 cwt., at 1*s*.	0	1	0
Sulphate of magnesia, ½ cwt., at 5*s*.	0	2	6
Watering twice	0	2	0
Mixing, at 3*d*. per ton	0	1	0
Turning twice, at 3*d*.	0	2	0
Cartage and spreading, at 1*s*.	0	4	0
	£2	0	6

* Journal, vol. xi. pp. 71, 72.

Where soot is easily available :—

Soot, 8 cwt. (32 bushels), at 3*s*.	£1	4	0	
Earth, 3 tons, at 1*s*.	0	3	0	
Bone-ash, 1 cwt., at 5*s*.	0	5	0	
Common salt, 1 cwt., at 1*s*.	0	1	0	
Sulphate of magnesia, ½ cwt., at 5*s*.	0	2	6	
Mixing	0	1	0	
Turning once	0	1	0	
Cartage and spreading	0	4	0	
				£2 1 6

Malt-dust is available in some districts where it is not much valued as food, and I have, therefore, formulated this substance as manure :—

Malt-dust, 6 cwt., at 4*s*. 6*d*. per cwt. ..	£1	7	0	
Earth, 2 tons, at 1*s*.	0	2	0	
Common salt, 1 cwt., at 1*s*.	0	1	0	
Sulphate of soda, ½ cwt., at 5*s*.	0	2	6	
Sulphate of magnesia, ½ cwt., at 5*s*.	0	2	6	
Watering twice (liquid manure), at 6*d*. ..	0	1	0	
Mixing, at 1*s*.	0	1	0	
Turning once, at 1*s*.	0	1	0	
Cartage and spreading, at 1*s*.	0	2	0	
				£2 0 0

I am acquainted with an instance in which 200 lbs. of malt-combs and 3½ cwt. of common salt per acre, applied early in February, produced an excellent crop of grass; but any such treatment is taking advantage of the land, and should not be repeated. It is moreover bad farming to apply 3½ cwt. per acre of a soluble substance, like common salt, when so much less is really needed and will be equally efficient.

The usual application of malt-dust here is from 400 to 600 lbs. per acre, and it never fails to produce a good crop of grass. Salt should always be used with it.

Malt-dust is said to consist of—

Organic substances		91·5
Containing nitrogen	4·0	
Inorganic substances		8·5
Containing potash and soda	2·0	
Lime and magnesia		0·9
Phosphoric acid		1·4
Silica		3·6*

If guano be employed, an economical and efficient method appears to be the following :—

Best Peruvian guano, 2½ cwt., at 15*s*. ..	£1	17	6	
Common salt, 1 cwt., at 1*s*.	0	1	0	
Sulphate of magnesia, ½ cwt., at 5*s*. ..	0	2	6	
Earth, 1 ton, at 1*s*.	0	1	0	
Mixing and spreading	0	1	0	
				£2 3 0

* Stockhardt, p. 168.

The following mixture can hardly be called manure, but, as it is said to destroy moss, it is included:—

Lime	$1\frac{1}{2}$ ton.
Salt	$\frac{1}{2}$ ton.

The salt should be dissolved in the water with which the lime is slaked, and the whole applied after a sharp harrowing. The extirpation of moss is not attributed to lime and salt only, for ammoniacal liquor from gas-works is said to destroy moss more permanently than lime.*

I would remind the farmer, however, that the effects of this substance are altogether exhausting, and that it must be alternated with manures which contain other elements of plant-food, or the land to which it is applied will speedily diminish in productiveness:—

Gas liquor 150 gallons, diluted with 500 water, gave—

Nothing	$20\frac{1}{2}$ cwt. hay.
Dressed	$61\frac{1}{2}$,,
Gain	41 cwt. hay.†

This land must have been exceedingly rich in all other elements of grass, or it could not have given so large a yield for such an application.

I apprehend the destruction of moss is due to *the grass* and not to the substances applied as manure. Anything which promotes the growth of a good crop of grass is destructive of moss, for the grass smothers the moss and kills it, and then new grass-plants take its place. Moss appears to me to be merely a lower form of vegetable life, which occupies land chemically unfit for higher vegetation, and when we remove the water (if wetness conduce to its growth) and supply the elements of nutrition for higher forms of life, the moss disappears, and, in meadows and pastures, grass-plants occupy its place. A moss-killer, then, is such merely because it is a grass-producer.

Rape-dust may be used economically, and, for a change, efficiently:—

	£.	s.	*d.*
Rape-dust, 5 cwt., at 6s. 6*d.*	1	12	6
Common salt, 1 cwt., at 1s.	0	1	0
Earth, 2 tons, at 1s.	0	2	0
Mixing	0	1	0
Turning once	0	1	0
Cartage and spreading	0	2	0
	£1	19	6

* Johnston, Agricultural Chemistry, p. 213.

† Johnston, Experimental Agriculture, p. 191.

Foul lime from gasworks may be beneficially applied to grass-land; but it is better to apply it to the grass as it comes from the works than to make a compost of it with earth, as farmers commonly do. It contains sulphide and hyposulphite, as well as carbonate and sulphate of lime, and the mixture with earth and turning has a tendency to convert all the sulphur by oxidation into sulphates. A ton per acre, applied once in from seven to ten years, could hardly fail to do good.*

Soaper's waste might be used with great benefit at considerable intervals, say every fifth or seventh year. It contains alkaline salts as well as lime, and, if turned up with three times its weight of soil and applied at the rate of a ton per acre, must be useful. It ought to be tried in cases where grass is *sour*. The prejudice against it arises from misapplications.

Very few farmers have any conception of the exhausting character of grass. They never realize the quantities of matter removed, and consequently they never realize the pressing necessity for quantities of matter to be added if their grass is to be kept at a maximum of productiveness. A volume of reasoning would have less avail than an actual exhibition of quantities, and I therefore earnestly entreat their careful attention to the following table.

1000 lbs. of the dried plants contain:—

Plants.	Nitrogen.	Phosphoric Acid.	Potash.	Lime and Magnesia.	Silica.
	lbs.	lbs.	lbs.	lbs.	lbs.
Pine forest, 80 years old	3	¼	½	2	¼
Beech fruit, 100 years old	5	1	1½	5½	1
Meadow-grass (hay and aftermath)	14	16	17	8	20
Wheat, ripe (grain and straw)	10	4½	5½	3½	20
Rye, ripe ditto	9	4½	6½	3¼	18
Barley, ripe ditto	11	4¾	7	5¼	20
Oats, ripe ditto	10	4½	7	4½	21
Winter rape ditto	12	8	13	13	2
Peas, ripe ditto	21	5½	11	16	2
Potatoes, ripe (tubers and haulm) ..	16	6½	22	11	3
Beet (roots and foliage)	18	4	21	7	2
Clover (in flower)	20	5½	20	20	2
Tobacco, green (leaves and stalks) ..	20	5¼	24	40-60	8 *

The full significance of these figures will be apprehended by comparing the *total quantities* of the several crops reaped from an acre, *e. g.*:—

* I have tried gas-lime in different quantities and on different kinds of land, but with uniformly bad results. It deepened the colour of the grass, but gave it a coarse wiry character, which made it particularly unpalatable to cattle; and several years elapsed before they would graze readily on the spots where it had been applied. It is quite possible that in other localities it may answer better, but I would recommend great caution in trying it.—H. S. Thompson.

† Stockhardt, p. 292.

Wheat 25 bushels of 60 lbs., and straw $1\frac{3}{4}$ ton = $48\frac{1}{2}$ cwt.
Barley, 40 bushels of 63 lbs., and straw 1 ton = $42\frac{1}{2}$ cwt.
Hay, first crop, $1\frac{1}{2}$ ton; second, 1 ton .. .. = 50 cwt.

Throughout the preparation of the grass manures, a mixing with earth of some kind (preferably clay, which has been dried and pulverized) has been recommended, and it may be well to give the reason of this. Grass is covered with a coating of silica, which forms a shiny varnish, just like that seen on the straw of wheat. This silica must be taken up in solution and deposited where it is found, and yet it is quite insoluble itself, and the natural compounds existing in the soil are almost insoluble likewise. It is required in large quantity, as an inspection of the above table will show, where the number which represents the silica in grass is larger than that which represents any other constituent. The same is seen in the analyses of Boussingault, page 222, and remarkably in that of rye-grass by Thompson, on the same page. In order to grow grass, therefore, a due supply of soluble silica at the roots of the plants throughout the season of growth is as requisite as a supply of ammonia, or potash, or phosphorus, or any other constituent found by analysis. The natural supply of this element in a soluble state is probably always deficient, and one of the problems of successful agriculture is the supply of a due quantity in a suitable form at the right time. Mixing earth with manurial substances during their decomposition tends to liberate a quantity of silica in soluble combinations ready for use as soon as applied. When decomposition of organic substances takes place, their elements become oxidized and form new compounds. Chlorine unites with hydrogen, and forms hydrochloric acid; sulphur with oxygen, and forms sulphuric acid; carbon with oxygen, and forms carbonic acid, &c.; and these unite with alkalies and form salts. How these set free silica in the earth, with which they are in contact, is described by Liebig:—

"The effect of ammoniacal salts is not the same as that of free ammonia. These salts contain an acid which exerts an action on the constituents of the soil—an action not exerted by pure ammonia. The acids of the ammoniacal salts render the earthy phosphates more soluble in water than they would otherwise be. These acids also render *available the silicates*, that is, they produce such a *decomposition of the natural silicates*, that the constituents of these minerals acquire a degree of solubility in solvents, which, while in the form of natural silicates, they either do not possess, or possess in a far lower degree. While the silicates are thus acted on, their silica or silicic acid (*which is indispensably necessary to the graminea*) is brought into a state in which it is soluble in water, so that all the rain-water which comes in contact with it finds and dissolves a certain quantity of silicic acid beyond that quantity which the same amount of rain-water would have found available without the ammoniacal salts. By means of the atmospheric constituents accumulated in the soil,—by means, for example, of ammonia,—the action of the mineral constituents, which are present in available or soluble forms, is accelerated, that is, increased in a given time.

"By means of ammoniacal salts, a part of the insoluble mineral constituents present in the soil is rendered soluble, and a larger fraction of the entire sum of mineral constituents is rendered active, or capable of entering into the plant; consequently by manuring with ammoniacal salts there is removed from the soil, in the excess of produce reaped the first year, a part of those mineral constituents which would have been rendered soluble and available by natural causes in the second year. The soil *in the second year is poorer* in these available mineral constituents than it would have been had no ammoniacal salts been applied in the preceding year." *

By the plan recommended we set free silicates and other compounds in the heaps, and add them to the fields, so that exhaustion is prevented. I have recently met with a striking practical confirmation of the theory here adopted, and it is presented to the farmer as the teaching of one whose knowledge was exclusively the result of observation, and who contributed largely to improve British agriculture. The extract is from a pamphlet on farmyard-manure, published in 1828 by the late Mr. Blaikie (the well-known steward to Mr. Coke), which I recently and for the first time met with accidentally at a friend's house:—

"Much has been said and written upon the subject of the valuable properties of urine, and of the sweepings of farmyards, as manure for grass-land. It has been recommended to collect the whole wash of the farmyard in reservoirs, and to convey it thence into the fields in water-carts; but this theory should not be reduced to practice unless it is ascertained that the benefit to be derived from the manure so conducted covers the expense. It is a good method (where situation will admit of the practice) to collect the wash of the farmyard into tanks, where a body of water can be thrown into it sufficient to effectually irrigate some adjoining piece of grass ground situate upon a lower level. It is also an advisable method to throw litter, scourings of ditches, and such other refuse, into the tanks in sufficient quantity to absorb the urine and wash of the yards which run into them. Compost so collected is admirable top-dressing for permanent grass lands, or for young clover layers."—p. 7-8.

Common salt is included in every manure here recommended, because experience has shown its beneficial action upon grass whenever it has been properly applied, and because the analyses show that grass always contains both its elements, chlorine and sodium.

The quantity recommended is 1 cwt. per acre, which is more than a sufficient addition to the natural supplies for the largest crop of grass we can imagine as being reaped from an acre; and the *annual* application of this substance is justified by Mr. H. S. Thompson's experiments on the power of soils to absorb manure. He says:—

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* Royal Agricultural Society's Journal, vol. xvii. pp. 301, 302. *Vide* also my Essay on Fermentation of Manure, Royal Agricultural Society's Journal, vol. xvi. p. 323, *passim*.

"The next experiment I tried, and the last that I shall mention on this occasion, was one to ascertain whether the affinity of the soil for salts of ammonia extended to other salts. Ten grains of common salt were mixed with a portion of the soil last mentioned, and water poured upon it till 12 oz. had passed through: on evaporation [of the water which had filtered through the soil], 9 grains of the salt were indicated by its equivalent of chloride of silver being obtained. Nine-tenths of the salt applied were thus washed out unchanged by the first 12 oz. of water which passed through the soil; and the inference is clear that, if the application of common salt be of any service to light land, the benefit can only be of a very temporary nature."

Supposing this to apply generally, it indicates a necessity for small annual dressings of salt for the hay-crop, instead of a heavy dressing once in a series of years, and, since it is the body *in minimo* which rules the crop, establishes a probability that the hay-crop is often less than it would be owing to the want of common salt.

The following instance may show the effect of *partial* instead of *complete* manures:—

Bones.—Bones are said to produce wondrous results upon the old grass-land of Cheshire, as theory would lead us to expect. Dairy pasture is continually robbed of phosphates to supply the requisite quantity for the daily yield of milk, whereas, if those pastures were stocked with fattening cattle, nearly all the phosphorus would be returned in the excreta. We are quite prepared, therefore, to find that a large dressing of bones produces large and lasting influence upon the Cheshire dairy land. Still we shall err greatly if we consider bones an adequate manure for grass. They can only act by supplying a *part* of the wants of vegetation, and, in whatever excess they may be applied, will fail to produce an effect, unless all the other food required for growth be available. This was well exemplified by a case which came under my notice. A gentleman of my acquaintance had heard of bones for grass, and determined to try them. He applied a ton per acre of ground bones to a field near his house, and had, to use his own expression, a forest of grass. He never saw so large a crop. It was generally estimated at three tons of hay per acre. The after-grass was also an enormous crop, nearly equal to the first. Being ignorant of chemistry, and thinking that land could not have too much of a good thing, he gave the same field the same quantity of the same kind of bones the following year, when he expected a result similar to that obtained before. This time, however, he was disappointed; for, notwithstanding his ton of bones per acre, containing, besides phosphates, much gelatine, with 18 or 19 per cent. of nitrogen, he had not above an ordinary crop. He and his neighbours were utterly puzzled. It was clear that the bones brought the crop before, and *therefore*, in their

method of reasoning, they ought to have brought it again; and their failure was really past human comprehension. I shall not easily forget the look of inquiring astonishment with which he asked me the cause of the failure, nor the one of repressed but unmistakable incredulity with which he received the explanation. We cannot wonder at mistakes on the part of farmers, when we meet with such instances as these among gentlemen of education, by no means deficient in observation, and who farm for pleasure.

Will it pay to manure grass-land annually, so that it may attain a maximum of fertility?

We must confess, the generality of farmers appear to think not. Their views and practices are pretty fairly represented by the following extract from Mr. Bennett's "Essay on the Farming of Bedfordshire":—*

"Within the last ten or twelve years the proprietor has allowed much of the second-rate quality [of grass] to be broken up—a boon which could hardly fail to be appreciated by his tenant. . . . A portion, however, being laid pretty well to all the adjacent farms, *they supply a quantity of useful meadow-hay, without cost of manure to the farmers*, and are, therefore, very properly regarded as a valuable adjunct to the farms."

"A quantity of useful meadow hay (and scanty innutritious pasture might have been added), without cost of manure to the farmers!!" is intended to describe all the grass-land of a particular locality, except first-rate pastures. Might not the remark apply to the majority of the second-rate and inferior grass of the three kingdoms? I fear it might.

The relative worthlessness of this "meadow hay, without cost of manure," contrasts strikingly with the costly manuring and enormous crops of good hay obtained by Mr. Horsfall, and described in the same number of the Journal. Mr. Horsfall says:—

"I reside on the borders of a district in Yorkshire, over which you may travel 50 or 60 miles without seeing, except here and there, an isolated patch in tillage; and I am enabled to state from observation that in this extensive tract of permanent grass the occupiers depend almost wholly on the excrement of their cattle for maintaining the fertility of their land."

All the land being in grass, the farmers have no other use for their dung. If they possessed any arable land, the grass would probably fare much worse.

Mr. Horsfall informs me that he applies twelve to fourteen loads of manure per acre, and his paper shows that he applies 2 cwt. of guano in addition. Does this pay? We will see.

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* R. A. S. Journal, Vol. xviii., p. 17.

	£.	s.	d.		£.	s.	d.
12 tons of manure, at 9s. 8*d*...	5	16	0	$2\frac{1}{2}$ tons of hay, at 4*l*.	10	0	0
Carting and spreading, at 1s. 3*d*.	0	15	0	$1\frac{1}{2}$ ton aftermath-hay, at 3*l*.	4	10	0
Guano, 2 cwt., at 16*s*.	1	12	0		£14	10	0
Road scrapings ?							
	8	3	0				
Rent and taxes (say)	2	0	0				
	10	3	0				
	14	10	0				
Profit	£4	7	0				

No credit is taken for the autumn and spring feed of sheep.

This is confessedly an extraordinary case, and quite impossible in ordinary circumstances. No farmer could spare such a quantity of dung, however it might pay. Let us take an ordinary case. A gentleman of my acquaintance occupies a farm belonging to Lord Westmorland, which is as poor as any land can be which is worth culture. It is tithe-free, and four miles from a large town, and lets at 25*s*. per acre. There are about seventy acres of grass, which had been treated upon the Bedfordshire principle for nearly half a century by a tenant who was compelled to emigrate. This grass-land produced less than half a ton per acre the first year of the present tenant's occupation, and the after-grass corresponded accurately to the hay-crop. It has now been manured annually with stable dung, carted from the town and placed under a shed till it became too wet with the excreta of pigs,* which lived upon it, to give them a comfortable bed. In this state it was carted out, and six loads per year were applied per acre. The dung was but little reduced when put on; and had it not been systematically applied early, it would have incommoded the mowers. Indeed, in some instances, the men have complained of it. This grass-land now gives $1\frac{1}{2}$ ton per acre of hay all round, and more after-grass than it gave of hay the first year. Does this pay?

We will assume that the first year's crop was the normal one, and that it paid rent, taxes, haymaking, and other expenses, though this is not the fact.

Then 1 ton of hay due to manure = 4*l*., and extra after-grass 5*s*. per acre.
4*l*. 5*s*. × 70 = 297*l*. 10*s*.

6 tons of manure, at 5s.	£1	10	0
Cartage, at 3s.	0	18	0
Filling and spreading, at 1s. 3*d*. ..	0	7	6
	£2	15	6

* The reader will bear in mind that pigs' urine resembles that of man, in containing phosphates.

2l. 15*s.* 6*d.* × 70 = 194*l.* 5*s.*

	£	s.	d.
	£297	10	0
	194	5	0
Profit on manuring	£103	5	0

Is it commercially worth a farmer's while to lay out 194*l.* 5*s.* to make a profit of 103*l.* 5*s.*? The whole matter may in truth be reduced to this.

I will put another case also within my own knowledge, and which differs from the former ones in being in all its details such that it is within the power of any farmer, wherever situated. A meadow (ten acres) had been mown annually for a long period. For five years no manure of any kind had been put upon it, but prior to that time it received (I believe) six sacks of soot per acre. It was much impoverished, and in 1855 produced barely half a ton of hay per acre; indeed, to get this quantity, I think it was not mown until the reapers had begun to work in some neighbouring wheat-fields. In 1856 it received a ton per acre of clay, which had been saturated in the purifiers of some gas-works in a neighbouring town. The clay was dried and pulverized, and sprinkled over the surface of the field very early in January. In 1856 a crop of 1½ ton of hay per acre was carried by the first week in July, and subsequently the after-grass was sold to the tenant of an adjacent farm, to be eaten by his sheep and cattle till Christmas, for the sum of 30*s.* per acre! As soon as cleared, the field was again dressed with the same manure. On the 27th of June, 1857, a crop of hay, estimated at 1¾ ton of hay per acre, was stacked, and the after-grass was again purchased by the farmer who bought it the year before, for 30*s.* per acre. Will this pay?

	£.	s.	d.
1 ton of hay per acre, at 4*l.*	4	0	0
Half of after-grass, at 30*s.*	0	15	0
	£4	15	0
1 ton of manure	1	1	0
Cartage	0	2	6
Spreading	0	1	6
	£1	5	0
	4	15	0
Deduct cost of manure, &c.	1	5	0
Gain per acre	£3	10	0

3*l.* 10*s.* × 10 = 35*l.* gain on 10 acres.

Is it commercially worth while to expend 25*s.* to obtain a return of 4*l.* 15*s.* per acre, leaving a profit of 3*l.* 10*s.*?

The essential difference between this case and the former ones is, that the manure employed may be purchased like guano or bones, and consequently that no portion of the already deficient supply of farmyard dung is taken to fertilize the now neglected grass. On the contrary, the grass-land is a contributor to the land under the plough, to the full extent of all the extra manure arising from the increased quantity of hay consumed on the farm. But a single case of the employment of this manure is here adduced, because that is sufficient to illustrate the subject upon which I write; otherwise, the experience of various soils over hundreds of acres might be adduced to show that we may rely upon it for grass as we rely upon bones for turnips. It has never yet failed, nor, to my knowledge, produced a less crop than upon the field mentioned.

A number of composts has been given above, in order that, however situated, the farmer might find something suited to his needs and practically available. Will they pay? Positive evidence of their employment cannot be given, because they are new; but any one competently skilled in the chemistry of agriculture, and familiar with English farming, will see that there is a well-grounded probability of their answering fully the end for which they were devised. I shall take them to produce an increase of ¾ ton of hay per acre, and double the normal quantity of after-grass:—

	£.	s.	d.	
Average cost of compost per acre	2	0	0	
¾ ton of hay, at 4*l*.	3	0	0	
Half of after-grass, at 10*s*.	0	5	0	
	3	5	0	
	2	0	0	
Profit	£1	5	0	per acre by use of compost.

Again, is it worth while to expend 2*l*. per acre to make a profit of 25*s*.?

A leading article in the 'Agricultural Gazette,' of October 25, 1856, on 'the Growth of Funguses in Pastures,' affords a lucid exposition of the evil of poverty and the benefit of manure. It shows the extent to which the farmer has the fertility of grass in his own hands, the permanent improvement effected by a course of judicious manuring, and the permanent deterioration caused by withholding manure.

"In all poor pastures the duration of the life of a species of grass is very precarious, as evidenced by the quantity of decayed tufts which are seen in such situations at most seasons of the year. As regards poor *meadows*, it is quite astonishing the changes that take place in the position of the grasses

according to circumstances; thus a poor upland, consisting for the most part of Upright Brome-grass, False Brome-grass, and Crested Dogstail, will suddenly change by merely folding sheep on a portion from day to day; and those very grasses will die out before the advance of Perennial Rye Grass, Cocksfoot, and Meadow Grass. The truth is, these better grasses suitable to an improved soil are all of them more perennial in their nature and habits, and are kept so because cattle continually crop them down, whereas poor grasses are refused by cattle, they seed without interruption, and then, having performed the important function of reproduction they die out, and the decaying roots, on the approach of damp and fogs become the nidus of funguses.

"If from poverty of soil, too frequent haymaking, &c., this dying out of the grasses and consequent encouragement of funguses be observed, it is obvious that liberal treatment will soon effect a cure. On the rich pasture lands of Cheshire funguses were most abundant, but how rapidly have we seen them dispelled before a compost of bones, ashes, and refuse, especially refuse from old buildings!" [which probably contained nitrate of lime].

"Again on the forest marble clays of Gloucestershire, we have seen a slight dressing of guano increase the crop of grass but ruin the funguses for some years, so as to encourage haymaking where it was scarcely before thought of. But this latter fact only proved more strongly the truth of the theory we are advocating, as two years' haymaking [without adequate manuring of course] has brought the pasture to its former poverty, and the funguses to their previous luxuriance."

This, being interpreted, signifies that we have grass-land poor from bad treatment, as most of the grass of England now is: that by better treatment we may make an enormous improvement, giving a large present profit, and which a course of judicious management will render permanent: that by neglect we may speedily bring back the condition of things, which previous manuring had altered for the better, and so prove the truth which so many other passages of agricultural life will illustrate and confirm, "*there is that withholdeth more than is meet, and it tendeth to poverty.*"

Change in the Character of Produce by the Application of Manure.

An instructive illustration of this occurred on the farm of Mr. J. R. Bywater, Middleton Grange, near Leeds. That gentleman kept a dairy of from twenty-five to thirty-five milch cows, and carefully drained his cow-houses and dung-heaps into water-tight tanks, and he thus describes his experience of the effects of dressing grass with the liquid.

"I collected the cow-water, with the drainings from the manure deposits, in a tank, and caused this fluid to be spread upon the grass-land alternately, say to the extent of about thirty acres annually. The first and second dressings produced immense crops of the ordinary kind of grasses to be found in our locality, and one field in particular (after the second dressing), which had been under the plough and had been laid down to grass six or seven years before I commenced the use of the liquor, produced so much trefoil as was equal in appearance to five-sixths of the whole crop, which was of great length and

thickness. This trefoil evidently sprang up from seeds which must have laid dormant in the ground until this new fertilizer was applied.

"My experience, however, in the use of tank liquor as a dressing for grass-land resulted in the discovery that by its exclusive application in successive years a very strong grass was produced, which appeared to destroy by its rankness the white clover and all the finer and more delicate kind of grasses; whilst a return to the use of farmyard manure, as a change, restored all the various kinds which had usually grown before. The system I ultimately adopted, and which I found to act most beneficially, was to give alternate dressings with liquor and yard manure, and my crops of hay were always abundant, and contained all the ordinary grasses in rich proportions."

I am indebted to Mr. Bywater for the knowledge of another instance of one-sided manuring which illustrates the position above taken, but in which part of the ordinary produce was so stimulated as to take exclusive possession of the land to the destruction of the rest.

A field in the neighbourhood of Leeds received repeated and heavy dressings of the alkaline salts extracted from the clinkers of furnaces, and the result was that certain of the stronger and coarser grasses were pushed to an enormous growth, so as almost to resemble reeds, while the finer grasses disappeared.

These two instances suggest the impropriety of dressing grass continuously with any manure which does not contain all the elements of plant food, and indicate the wisdom of varying the application from year to year when persons use (as they wisely may do) manures which contain an excess of particular elements of fertility and a defect of others. The cow-water should not be rejected because it wrought such an alteration, but should be regarded as a one-sided application which the next year's dressing was to balance. In like manner the alkaline salts need not to be rejected, but should be resorted to at intervals only; the excess or defect of each year being subsequently compensated, and the land being kept in the same condition as if it were possible to give it annually a complete supply of the substances which enable it to yield a maximum of the best produce.

The omission of *Sewage* would render this paper culpably incomplete, and yet the application of sewage even to grass must ever be limited. The excessive quantity of water which must be put on in order to obtain sufficient fertilizing matter is so large, that the prudent and profitable application appears to me to be restricted to localities where it can be got on the land by the force of gravity, and where the soil is so porous and sloping as to allow a rapid removal of the excess of water. Moreover the grass grown by sewage requires to be frequently mown to prevent rotting, and therefore soiling seems the correlative of sewage manuring. That soiling will pay on a large scale, except for the production of milk and butter remains to be

proved, and if it do not pay there is an end of the matter. Farmers and landowners cannot afford to sacrifice their incomes to crotchets, nor, in our densely peopled country, can we spare the produce of a single acre of available land. The Craigentinny meadows near Edinburgh afford a splendid instance of success due entirely to a judicious application of sewage, and wherever the same conditions obtain sewage should be applied in like manner. A ready and cheap vend for dairy produce, the means of applying the sewage by gravity, or at most by one pumping (as on some of the Edinburgh land), without any outlay for costly apparatus of distribution, and above all porosity and declivity of soil adequate for the removal of surplus water, are conditions to be fufilled before a reasonable expectation of profit can be entertained. Where these meet, the farmer will do well to try a few acres, and extend his breadth of sewage irrigation accordingly as he finds it pay. It is far better that the sewage of towns should run to waste into the ocean, than that our cultivators should apply it to the land and lose money by the application.

Of course I know what imaginative theorists will say to this, but after reading all their arguments (and sophisms too), and weighing against them the sober truths of experience and analysis, I can come to no other conclusion.

But may not the farmer irrigate with his own home-made liquid manure? Where he has command of water and can do it without a constant charge for labour he may, but otherwise I entirely concur in the sentiment of one of our leading agricultu-rists: "I am more and more averse to liquid manure: the labour is endless."

Let the liquid manure be mixed with soil, finely sifted ashes, and such other material as the farmer can command, and the compost applied liberally to the grass of the farm, and the profit thus derived will far exceed that to be made by the costly plans which have recently been proposed for adoption.

I must observe, however, that the most prolific source of grass manure is human excreta, now expensively wasted in town sewage. Large sums of money are now expended to enable us to waste what may be economised with advantage in every way. The present absurd water-carriage of excreta must be abandoned, and sewers employed for their legitimate purpose, viz., to carry away waste water to its natural receptacle the river. Moveable boxes should be attached to every house, and removed weekly in summer, fortnightly in winter. A cistern filled with dry pounded clay would be placed overhead, and a simple mechanical contri-vance would throw down a measured quantity of this every time the handle was raised as water is now let down a closet. Nature's deodorizer and disinfectant would prevent the escape of injurious

exhalations, and the refuse would be removed by water or other carriage some miles into the country, to await under sheds the farmer's season of use. This manure could be screened and applied by distributors, and would produce crops of grass which experience alone will enable us to estimate. *Every* element of grass is contained in this manure in large abundance, and while its preparation formed a sanitary improvement of much value to towns, its use would be a boon of enormous value to the country.

St. Andrews, Wakefield.

XII.—*On Laying-down Land to Grass, and its subsequent Management.* By H. S. Thompson.

Nearly a century and a half have expired since the sagacious Dean of St. Patrick's penned the well-known and often quoted maxim which so pithily points out the importance of growing two ears of corn in the place of one, and two blades of grass where but one had been before. Whole nations of cultivators have applied themselves to the accomplishment of this object,—a task apparently so insignificant in its dimensions, but really so immense in its influence on the well-being and even on the destiny of large portions of the human race. If any records had been kept of the results accomplished, it would doubtless be found that at the close of the eventful century and a half above alluded to not only two but many ears of corn do actually flourish in the room of one, and contemporaneously with this improvement in our agriculture a corresponding advance has been made in arts, in arms, and all the other attributes of greatness, so that the title of *Great* applied to our little island can no longer be considered a misnomer, even though its people be compared with the mightiest nations either of the present or the past. The first portion of Dean Swift's maxim has, then, been amply realized: the two ears of corn have been grown, and the cultivators, in common with the whole nation, have reaped their reward.

But what of the Grass? Few farmers could, we fear, give a satisfactory answer; few could say that they had even *tried* to do more than keep their grass-land *up to the mark*, that mark being the old landmark of quantity and quality. In short, they have only tried to produce the same number of blades of grass as heretofore. Fifty years ago, previous to the most striking improvements in our arable farming, Arthur Young estimated the best meadow land to produce 5 tons of hay per acre per annum (at two mowings), and the best grazing-land to feed an ox of 90 to 100 stone (14 lbs.) and 1 large Lincolnshire sheep per acre!

Who can say, in 1858, that he has done more? How many can claim to have done *as much?* Doubtless bogs have been drained, mountains and moors cleared of rocks and rubbish, and many thousands of acres made to grow grass where none, or next to none, grew before; but, taking the great body of the grass-land of the kingdom, is it not notorious that farmers—good farmers—men of capital and intelligence, do, for the most part, look at their grass-land as a kind of fixture, almost as much so, in fact, as the rooms of their houses? There is a parlour here and a kitchen there, and no one would think of letting one encroach on the other; so there is a feeding pasture here and inferior grass-land there, and as such they are allowed to remain; and if these lands are not ploughed out or permitted sensibly to deteriorate, this is considered quite good enough management for the grass, even on a farm where the tenant is introducing the most enlightened and excellent management into the cultivation of his turnips and his corn.

Such general results must spring from equally general causes, and we believe one of the most influential reasons to be, that the returns from capital laid out in the improvement of grass-land do not come so directly into the pocket as those from corn, and are apt, therefore, to be underrated or lost sight of. Few farmers sell hay, and if, by more liberal treatment of their meadow land, the hay-stack increases in size so as to effect a saving in horse-corn and bring the store cattle into the pastures in spring in a more healthy and thriving state; or if the improvement made in a poor pasture enable the occupier to rear more young stock and in better condition; still the return on the outlay is mixed up with other questions, such as the market price of lean and fat stock at the times of sale and purchase, and it becomes extremely difficult to separate it from the general profit and loss account of the whole farm. In short, the farmer does not put the money derived from the improvement of his grass-land directly into his pocket, and he is, therefore, not very sure whether what he lays out in this way ever finds its way back or not. The result of a doubt on such a question it is not difficult to foresee;—so the grass-land has to content itself with what the half-starved cattle are compelled to leave behind them, added to a liberal allowance of *atmospheric advantages*, and its continued poverty is a standing proof that these resources are not of the richest, and will not bring us any nearer to the *two blades of grass.*

The time, however, has undoubtedly arrived when the rapid increase of our population, and their greater command over the comforts of life, have created an effective demand for so much larger a supply of well-fed meat, as well as of more perishable

articles, such as milk and butter, which cannot be supplied in perfection from distant countries, that it well deserves the consideration of those leading farmers who have already brought their arable farming up to so high a standard, whether they could not profitably bestow more of their attention on the hitherto neglected grass. The Royal Agricultural Society has already given great force and concentration to the efforts made for the last twenty years to improve the stock, the dairy, and the arable farming of this country, and striking improvements have been effected. Doubtless the great blot which disfigures British agriculture at the present day, viz. *the neglected state of so large a portion of the grass-land*, might also be removed, much to the benefit of all parties concerned, if the same energy and perseverance were brought to bear upon it. With this object in view, a prize was offered last year for the best essay on the management of grass land, and, as the competition has been brisk, two samples are presented to the reader, viz. the Prize Essay, which bears on its face abundant evidence of long experience and careful observation; and a cleverly-compiled report, by the Rev. Mr. Bowditch, which was highly commended by the Judges, and which brings together in one focus the opinions and ideas of many different and differently situated observers. Both kinds of contributions have a distinct value of their own, and the writer proposes also to add the result of his own experience on this question, that the improvement-of-grass question may from the first be treated not as a subject for a single article, but as requiring and deserving the fullest collection possible of practical ideas and trustworthy facts.

To begin at the beginning: What is the best mode of laying down land to grass? Having made numerous attempts to accomplish this difficult agricultural operation, and having met with very various success, it will probably be more instructive to describe in detail one or more of the cases than to commence by laying down general rules. About twelve years ago I took in hand 30 acres of land adjacent to the river Ouse, which I was desirous of laying down to permanent grass. Fifty years before it had formed part of my grandfather's home-farm, and had the repute of being good feeding pasture. He was tempted to plough it out by the excessively high price of corn, and the first three crops he had upon it averaged 10 quarters of oats each (worth 3*l.* per quarter), and realised more than the fee-simple of the land. But when the war prices had passed away the land still remained under the plough, and as it was loam of tolerably good quality, and very favourably situated for pasture, I resolved to try my hand at it, and to spare no reasonable expense in bringing it quickly back to its original state of good feeding

pasture. It was therefore fallowed, limed, and sown with rape, which produced a good crop and was consumed on the land by sheep; the seeds were then sown down without a crop, great pains having been taken to procure the most suitable grass-seeds for that description of land. They came up well, and the following spring were unusually luxuriant, and I was congratulated on the success of the operation. I was at that time thoroughly impressed with the truth of the Persian proverb, that "the sheep has a foot of gold, and turns to gold whatever it touches," and I accordingly resolved that sheep, and sheep only, should for some years enter my model pasture. The quantity of sheep which this field carried in the early months of the first season was very great, not less than 10 or 12 to the acre, and I flattered myself that so many feet of gold could not but produce a splendid result. Before the end of the summer, however, the rye-grass sent up its seed-stems, which the sheep would scarcely touch, and the keep then declined sensibly, and did not carry any quantity of stock after Midsummer. The field was very green the following spring, and carried a good many ewes and lambs in March and April, but its growth was much below that of the previous year, and as the grasses (especially rye-grass and crested dogstail) threw up their flowering stems, the pasture fell off both sooner and more completely than before. I was rather disappointed at this state of things; but knowing that the *second* and *third* were very trying years for all newly-laid grass, I determined to make such a liberal application of the golden foot as should terminate all suspense, and at once make this field what it ought to be.

Accordingly, as soon as the grass was about 6 inches high the following spring, I penned a large flock of yearling sheep upon it, giving them a fresh break of grass every day, together with as much linseed cake as they would eat. They cropped the pasture quite close, and when the flock had gone round the field, a fresh growth having sprung up, they were taken over it in the same way a second and a third time, until they had consumed several tons of linseed-cake, and made themselves very tolerably fat. The effect of this treatment was to produce a great rise of white clover, and the grass, though short, seemed sweet and succulent. Next year I expected to see a marked change in the pasture, but was much puzzled as well as disappointed at not being able to perceive any decided improvement. I still, however, believed this to be the most efficacious way of enriching grass-land, and resolved to give it a further trial. I accordingly again penned sheep on the land, giving them as before a full allowance of linseed-cake and a fresh break of grass daily. This year convinced me that I was altogether on a wrong tack, as

the pasture looked decidedly worse at the end of it than it had done yet. The finer grasses were getting scarcer, instead of increasing, and the white clover, though it did not immediately disappear, looked small and stunted. By close observation I became satisfied that the constant cropping of the sheep had a very prejudicial effect on all the finer grasses, and that those only which they partially rejected could make head against this repeated gnawing into the quick. I have been thus particular in describing the result of this experiment, because it gave me the clue by which I was able to interpret several previous instances of failure or very doubtful success, and has been of great benefit to me in subsequent years.

This was a singular but well marked case, in which there could scarcely be any mistake. The land was of more than average quality; the seeds came up well, and during the first season were strikingly luxuriant, whilst the subsequent treatment was such as to supply the land with an unusually large amount of fertilizing matter of the richest kind: nothing, in short, was wanting but success! Yet the failure was so marked, that the most careless farmer could scarcely have avoided pondering over it and trying to discover a solution of the riddle. I was slow, indeed, to give up my perfect confidence in the fertilizing tread of the sheep; but after the failure of repeated endeavours to find any other sufficient cause, I was reluctantly brought to the conviction that amongst young grasses the gnawing tooth was more than a match for the golden foot. Nothing, in fact, but the repeated cropping could explain the gradual but steady dwindling of the clovers and finest grasses, notwithstanding the uniform consumption over the land of such an amount of linseed-cake as would, if applied in the usual mode to any ordinary grass-land, have produced a luxuriant development of all the best fodder-plants. Following up this idea, I became satisfied that to graze sheep on young seeds intended for permanent pasture was a mistake, and that in all probability it had been the cause of several previous failures I had experienced. Up to that time I had never succeeded to my own satisfaction in laying down land to grass; but since making a rule rigidly to exclude sheep for some years from newly-laid grass during the season of active growth, I have never had a failure, though I have twice had occasion, for local reasons, to lay down fields of which the soil was strong clay. The method which I have found to answer best has been to sow a liberal allowance of the hay-seeds of the district, with a sprinkling of cow-grass and white clover; to sow them with a crop of wheat (one of the short-strawed varieties); to mow the first year, and as soon as the hay is removed, to give a good dressing of farmyard-manure, and then for some years pasture it

with cattle, beginning for the first year or two with young stock, until the turf is close and strong enough to bear the treading of heavy cattle. If farmyard manure is not to be had, 3 cwt. of best Peruvian guano per acre will prove a tolerable substitute, though by no means equal to the former. For some years a newly-laid pasture will, unless the land be of *very* superior quality, require assistance from time to time to keep it in an improving state; an occasional dressing of farmyard-manure is, of course, the best, but as this is rarely obtainable in sufficient quantity, it must be eked out by other means. One of the cheapest and most effective plans is to employ an old man with a donkey-cart to go round the pastures collecting the droppings of the cattle and making them into compost with road-scrapings, ditch-cleanings, &c.: when these sources fail, the droppings must be mixed with ordinary soil, avoiding sand, gravel, and lime. If a manure-collector be once appointed, numerous odds and ends of fertilizing substances will be found available which would individually be worth little, and which are now wasted because the regular staff of the farm are all engaged, and to take off one horse and man would often stop a plough or weaken a gang of labourers so as materially to interfere with more important operations. But the collection of manure should be incessant. The droppings of horses and cattle, especially if collected fresh, form a very important source of compost, and the improvement to the pasture is twofold: 1st, in the saving of that which is otherwise to a great extent wasted; 2ndly, by the cleansing of the pasture and the much more uniform grazing of the cattle when the droppings are not allowed to remain and produce coarse tufts for some months after. In collecting materials for compost, it should be borne in mind that all plants contain more or less of the elements required for the growth of the grasses, and that thistles and other succulent weeds, if mown and covered with soil whilst still fresh and sappy, materially assist in improving the heap, both by the fertilizing elements which they contain and also by the fermentation which they induce. This fermentation mellows and disintegrates the soil, and also fills its minute pores with gaseous matters, the result of the decomposition of the vegetable and animal compounds of which the compost should be partially composed. All compost should be turned and well mixed, once at least. The time that it should be left before and after turning will depend entirely on the materials of which it is composed. As a general rule, however, it may be assumed that the droppings of cattle, mixed with road-scrapings, will be ready for use during the winter after their collection; but if rougher materials be used, twelve months will probably be required to bring the heap into the friable state which is desirable. I attach particular importance to the collection of *vegetable mould* for top-dressing newly-laid grass-land: it

is as a manufactory of this substance that I have been inculcating the formation of compost heaps, containing all kinds of refuse vegetable-matter, mixed with earth. One reason why so many failures have occurred in laying down land to grass is, in my opinion, because sufficient attention has not been given to the state of the soil required for the growth of good grass. Where land is of a rich loamy character, there is no difficulty in getting it to swarth over with grass of good quality. Little more is required than to level it and leave it to itself, after brushing in the seeds, merely pulling up the thistles and other coarse weeds and rolling it the first spring when dry. With land of moderate quality, however, the case is very different; and, even where considerable pains are taken in preparing the land and obtaining good seed, the almost invariable result is, that the young layer is very good the first year, pretty good the second, *very indifferent* the third, and that it so remains for a succession of years, varying in length according to the particular quality of the land and the nature of the efforts that are made to give it a start, but not unfrequently in strong clay extending to twelve or fifteen years before it approaches in value to old grass land.

What is the cause of this long and unprofitable interregnum? As a first step towards answering this question, I would suggest to the inquirer to dig a sod a few inches in depth from any kind of old grass land, and he will find that immediately below the grass there is a certain amount of fine friable mould, darker in colour than the natural soil. This fine mould I shall refer to hereafter; but confining myself for the present to the difference of colour, it will be observed that this darker tint gradually wears out as you proceed downwards, until at a depth of a few inches it finally shades away into the ordinary colour of the soil. This difference of colour between the soil and subsoil is matter of common remark in arable land, but it is still more marked in old grass. In both, however, it is due to the same cause, viz., an admixture of vegetable remains with the soil. Let us first take the case of a light porous soil, which in its natural state is a loose, blow-away sand. Here the soil and subsoil are, as nearly as possible, identical both in colour and composition until, by the cultivation of turnips, clovers, and a long course of sheep husbandry, some amount of vegetable matter is accumulated in the soil, giving it consistency and power of retaining moisture. I have a striking example of the results of this process on a piece of land which was, until 1854, part of my own farm. With the agricultural history of this land for a long time past I am intimately acquainted. A portion of it had, from its position, been long coveted as an addition to my family estate, and was in consequence, in the year 1707, bought by my paternal ancestor much above its value,

though at the low money price of 6*l.* 10*s.* 9*d.* per acre. It is represented as being at that time a blow-away sand, partly consisting of waste and partly of arable land, which grew inferior crops of rye, and let at about 2*s.* 6*d.* per acre. A century and a half of improving cultivation have brought it into a state in which it will grow five quarters of wheat per acre in a good season, and it would be generally described as first-rate turnip and barley land. It lets for 50*s.* per acre, and land of no better quality in the neighbourhood has frequently been sold for 90*l.* to 100*l.* per acre. I have more than once endeavoured to lay down to permanent grass a piece of land on this farm, and have found that it is soon covered with short sweet herbage, and that it carries a heavy stock of sheep for the first two years; but the land has not sufficient strength to feed cattle, and the constant cropping of sheep destroys many of the best grasses. I have endeavoured by top-dressings and by liquid manure to force it into good permanent pasture, but, in consequence of the porosity of the land, which promotes rapid decay, very little accumulation of vegetable mould can take place, and constant manuring must be resorted to, which, on this description of land, would seldom be repaid: it is therefore recommended that light sandy loams should never be laid to permanent grass, unless where local convenience makes it of importance, and in that case an effort should be made before laying it down to give it a heavy dressing of clay or marl. The permanently improved quality of the herbage, and the increased power of retaining manure thus obtained, would repay even the heavy cost of carting 100 or more loads of clay per acre from some little distance.

Let us next consider the case of stiff clays. In all really strong land the principal obstacle to effective cultivation is the difficulty of producing and maintaining a good tilth. The elements of fertility are, in soils of this character, seldom wanting; but when in their natural state, the closeness of their texture makes it difficult for the roots of plants to make their way into them, nor can atmospheric air or water enter with sufficient freedom, so that the decomposition of manure and of the minerals is slow and imperfect, and does not furnish an adequate supply of materials for a rapid plant-growth. Deep ploughing, fallows, and repeated stirrings in dry weather, produce a temporary suspension of the evil; but the first heavy rain tends to consolidate the soil again, and, if left undisturbed, the variations of temperature and other atmospheric changes soon restore it to that heavy sodden state which is so unfavourable to vegetation, and which the farmer exerts himself to counteract by the repeated use of the hoe and the grubber. So soon, however, as such land is laid down to permanent grass, all the mechanical operations by

which the soil was periodically reduced to a friable state are necessarily abandoned, and it soon returns to its natural condition. I will assume that, before laying down to grass, the land has been well fallowed and limed; that it is clean, in good heart, and sown with seeds adapted to the locality. This is certainly assuming a good deal; but if any of these points have been neglected, the failure that will certainly ensue must not be attributed to the inherent difficulty of the operation, but to the farmer's own neglect of the indispensable conditions of success; and my object in discussing the subject is not to repeat once more what has often been said before, and is known to every intelligent farmer of any experience, but to grapple with the real difficulty which remains to be met after all the above-named preliminaries have been strictly complied with. I will assume further, that the seeds have been sown with a crop of wheat, as the shelter afforded by the growing corn is of great use to the young seeds on strong land, and the value of the corn will enable the farmer to afford a most liberal dressing to the young layer, and still leave a good balance in favour of sowing *with* rather than *without* a grain crop. After the corn has been harvested, the fresh sweet bite afforded by the young seeds will be a strong temptation to the owner to let a few sheep just "top it over," as the phrase goes; but the temptation must be resisted, as the undoubted prompting of his evil genius, and not a hoof should be allowed to enter the field.

The next question that arises is whether any manure should be applied the first season: I think not. The removal of the corn crop has doubtless taken out part of the *condition* of the land, which must be restored in order to keep the young grasses thriving, but the first season is not the one in which the want will be felt, and I have seen a dressing of manure do harm by smothering the young and delicate plants. The following season the grass should be mown, and after the hay is removed occurs one of the critical occasions which go far to decide the fate of the young crop. Then it is that the resources of the farmyard must be taxed to the uttermost. It must be borne in mind that a crop of corn and a crop of hay have been taken from the land, and that if the farmer does not make a handsome return for these benefits, the consequences of his illtimed parsimony will stare him in the face for many a long year. If the farmyard manure at his command will not enable him fully to meet the requirements of the case, let him eke out his dungheap with compost, to which 2 cwt. of Peruvian guano or 10 bushels of bones per acre have been previously added. Should the farmer be unable to screw up his courage to deal with his grass after this fashion—should he *calculate* that the bone or guano compost

would be sufficient without manure, or that a moderate dressing of manure would *do* without the compost—he will be wise to abstain altogether from laying strong land down to grass, as assuredly it will be more profitable to him whilst under the plough. But to those who in laying down land to grass do not contemplate converting it into an unprofitable waste, but intend it to be kept like the rest of the farm in a productive state, I would recommend that after the liberal manuring above described, applied in the autumn or early winter, the land should be well rolled the following spring, and grazed with young cattle for that year. It must not be expected that even this treatment will make the pasture at once equal to old grass, but it will prevent the sudden falling off which is so commonly observed in the second or third year after laying down. I do not recollect ever to have seen the causes of this rapid decline of fertility explained. It is matter of notoriety that it *does* occur, and apparently it is considered a matter of necessity that it *should* occur ; but a little consideration will, I think, show how this unsatisfactory state of things may be much mitigated, though perhaps not altogether removed. All the gramineæ that are of value for grazing or mowing purposes require a fine tilth or mould, as a condition of their successful cultivation. For the first year or two after strong land has been laid down it retains, to some extent, the porous texture induced by the thorough disintegration which it received in course of preparation for sowing. The second winter, however, generally obliterates all traces of previous cultivation, and the close and sodden state of the land which then supervenes is highly unfavourable to the growth of grass. The land may contain a sufficient supply of all the elements of plant nutrition ; but they are in a crude state, and a constant supply of oxygen is required to promote the decomposition of the mineral and vegetable matters, and their recombination in forms available as plant food ; so that if air and water cannot easily and quickly pass through the soil in repeated succession, a check is given to nature's underground cookery as complete as if the flues were stopped in the farmer's own kitchen, and the dinner had to be prepared without any possibility of lighting a fire. Hence the sudden falling off in the produce of newly-laid grass on strong land, and hence the necessity at this critical period for an abundant supply of plant food on the *surface* to compensate for the falling off from below.

In all old grass-land we find a layer of fine mould around and below the roots of the grass. This consists of vegetable remains, and fine earth brought up by the slow but constant agency of earthworms. I am happy to be able from my own observation to support the views entertained on this

point by the author of the preceding essay (see p. 226); with the exception that he appears to me to underrate the amount and value of the vegetable remains contained in this fine mould; but the action of worms, even on free soil, where there is nothing to impede their operations, is far from rapid, and on stiff clays it is slower still: on sandy loam I have found that wormcasts and decayed grass-roots unitedly accumulated a layer of soil not exceeding an inch and a half in 12 years, as tested by the descent of a well-marked topdressing of mineral matter. This rate of descent is much slower than that recorded by Mr. Darwin (quoted in Mr. Bowditch's paper, p. 225); but it is probable that the number of worms, and consequently the effect produced by their accumulated deposits, varies in different soils and situations quite as much, or more, than would be sufficient to account for the variation in the descent of mineral matters above alluded to. Those who have in their boyhood dug for worms for groundbait are well aware that one spadeful of rich well-manured loam will often do more towards supplying their wants than a whole hour's digging on poor sandy soil, and I am strongly of opinion that the good effects of manure on newly-laid grass-land are very much aided and increased by the stimulus thus given to the action and to the increase of earthworms.

I have already mentioned that the first year's produce from land sown with grass-seeds is almost invariably the best, and that after the second year there is a marked falling off, which may be much mitigated but cannot be altogether avoided without great outlay. This is so well recognised by Scotch farmers that it is unusual with them to allow land (unless under special circumstances) to remain more than two years in grass. There can be little doubt but that on land of moderate quality more profit may be made, and more food raised both for man and beast under this system than by keeping such land in permanent pasture. By the Scotch or convertible system, when two crops of grass have been removed, or consumed on the land, and the period of stagnation and decline has arrived, the land is renovated by cultivation, and the exposure to the atmosphere consequent upon ploughing out converts the remains of the grass as well as the minerals of the soil into valuable food for corn; but, when in permanent grass, the diminution of nourishment received in consequence of the land remaining unstirred has to be made good chiefly from extraneous sources, until repeated dressings of manure or compost, and the accumulated labours of our slow but steady friends the earthworms, have provided a store of fertile and finely-divided matter, immediately under the sward, which is thenceforward able to maintain the style and title of *old grass.*

Doubtless there are many considerations which combine to

maintain the large proportion of permanent grass which is to be found in England. Ornament, amusement, and long-established custom have each a certain degree of influence in deciding this question; but the cause which has more weight than the other three united, is the knowledge on the part of landowners that there is a store of accumulated fertility in old grass-land which, were it allowed to be ploughed out, would be entirely at the mercy of the tenant. Unless, therefore, the system of long leases should be generally adopted, under the protection of which landlords might give up the grass for the sake of a permanent increase of rent, it is probable that the "old grass" will long remain in its present state. It is consequently of great importance to call attention to the most available means of increasing the produce of that large proportion of it which is now making a miserable return both to landlord and tenant.

We will first take the case of meadow land. It is almost needless to say that if the owner of meadow land have a sufficient supply of farmyard manure, to be able to give it a good dressing every year, he wants no other improver, and I have already expressed myself in favour of applying it to the land immediately after mowing. This must be taken, however, with some qualification, as, if not sufficiently mellow to break up easily into small fragments, or if the land have a sandy or gravelly subsoil, the manure should not be put on till the approach of winter. Such plenty, however, of farmyard manure is comparatively rare,—almost as rare as it is common for a man to have so little of this universal fertilizer for his grass that he sees the necessity for adding something to his heap, and sits down to consider what it shall be. The first point to decide is whether he is most anxious to increase the *quantity* or the *quality* of the produce. It is a curious fact that on any old grass land of average quality, we can, by varying the application, exercise very extensive control over the quality of the grass, and even over the kind of plant which shall form the bulk of the herbage. I had my attention drawn to this subject many years ago when draining an old meadow on strong land. After the work was completed, some of the subsoil was necessarily left on the surface for a foot or two on each side of the newly-made drains. This produced so remarkable a crop of meadow foxtail, a grass which was not at all plentiful in the field previously, that at mowing time the field appeared as if ruled with double lines, one on each side of every drain. On another occasion a liberal dressing of very strong liquid manure—from a tank attached to my cattle-yard—applied to light land, produced such a heavy crop of white and red clover that the grass when mown almost appeared to consist of clovers alone, and the swathes were so heavy as very nearly to touch one

another. The sheet of white clover produced by a heavy dressing of lime on moorlands and other inferior pasture, where white clover had scarcely been seen before, is well known to upland farmers, and it would be easy to multiply instances of a similar kind; but none of those I have ever seen can be compared in point of variety and distinctness of result with the set of experiments which has now for some years been carried on by Mr. Lawes in his park at Rothamsted, and which I had the opportunity of examining in June, 1857. There might be seen, side by side, strips of the same old meadow, manured with *farmyard manure*, with *alkalies*, with *phosphates*, with *ammoniacal salts*, and with various combinations of these substances. By comparison with the unmanured grass adjoining it would be observed that the meadow in its natural state was one of only moderate grass-growing capabilities, yet some plots were loaded with a crop of the most bulky of our gramineæ, such as cocksfoot, rye-grass, foxtail, &c., all growing with a luxuriance which would excite attention even in a waterside meadow of the first class. Side by side with this might be seen a plot nearly covered with clovers, trefoils, and vetches; whilst the next plot in the series would perhaps scarcely furnish a single head of any of those tribes of plants. Mr. Lawes will, it is hoped, make public the exact results of this valuable series of experiments, and it is not necessary to say more respecting them here, than that it would be difficult for any one who has not witnessed them to imagine the strangeness of the appearance presented by the trial plots when growing such very different quantities and kinds of herbage, and the difficulty that would be experienced by a stranger, in persuading himself that they were all produced simply by the application of different manures to the same meadow.

Having now shown that the farmer has, to a great extent, the power of deciding upon the kind of grass that he will grow, I must next remind him that great fineness of quality is inconsistent with large bulk; and that if he requires hay for sheep or horses for fast work, he must be content with a moderate amount of produce. Bearing this in mind, I would furnish him with this general rule: that, when he wants *quantity*, he must use *guano*, *nitrate of soda*, *soot*, or other *ammoniacal* manure; and that when he wants *quality* he must use *lime* or *bones*. The following mixture I have found very effective, viz., a mixture of equal weights of best Peruvian guano, nitrate of soda, and common salt, to be used, in early spring, at the rate of 3 or 4 cwt. per acre, according to the condition of the land. If this or other stimulating mixtures should make the grass too strong and coarse, then lime or bones must be applied as a corrective; and, as their effects vary much on different soils, I should, in all

cases, recommend that a trial should be made of each in adjoining portions of the same field before either the one or the other be largely employed. A great deal of useful information as to the effects of these fertilizers will be found in Mr. Dixon's Prize Essay (*supra*, p. 204), and I would call especial attention to his remark (p. 213) that he has "found it the safest and soundest economy to obtain the effect at once, and not by niggardly or piecemeal applications." This more particularly applies to those cases where the herbage is altogether of an inferior description, and where to produce a change of plant it is necessary to make a much larger application than would be necessary where the herbage is tolerably good, and the dressing is chiefly intended to produce a good crop for one season.

The last point to which I shall call attention is the improvement of pastures, and there is scarcely a farm in the United Kingdom on which this kind of improvement is not wanted. An outlay in bones or lime of 4*l.* or 5*l.* per acre would convert a large portion of our second-rate pastures into good feeding-land. Every farmer knows the advantage of having some grass that will fatten bullocks, and if any is to be let there are always numerous offers for it at a high rent. Then, would it not answer well to occupiers to convert some of their moderate grass (rented, say at 30*s.* per acre) into land worth 3*l.* to 4*l.* per annum, by the outlay of 4*l.* or 5*l.* per acre? That this is practicable, they can easily convince themselves by an experiment or two on a small scale. Let them, however, bear in mind Mr. Dixon's advice "*to obtain the effect at once, and not by niggardly or piecemeal applications.*" Let them also consider the alternative. If they leave their pastures still in their unimproved state, they must continue, as at present, to fatten their cattle in the winter at a great cost of attendance and purchased food, or they must part with them in autumn, when half-fat, at a great sacrifice, or keep them in a straw-yard and lose what flesh they have picked up during the summer. If a fair balance were struck between the cost per stone of fat beef, when obtained in the one case by merely turning a bullock into a pasture lean and taking him out fat,—and on the other hand, by supplying him with artificial food, shelter, and constant attendance for several months,—shrewd men like the bulk of our tenant-farmers could hardly fail to be struck with the great disparity, and the corresponding advantage they would derive if they could from time to time convert a few acres of store pasture into feeding-land. The method of doing this which I have observed to be most effective does not differ much from that recommended for meadows: the great difference in the two cases being that, whereas guano, nitrate of soda, and other top-dressings which are of easy solubility, produce on a *meadow*

a rapid effect, but are not permanent because by mowing you take the whole produce from the land—the same applications to *pastures* have a much more lasting effect, because the increased number of stock that they will carry leave a corresponding amount of droppings, both solid and liquid; and if the system of collecting compost recommended in the early part of this paper be adopted, these temporary applications will be found to produce a lasting benefit. It must not be forgotten that if a poor pasture be thoroughly bad, a great effort must be made entirely to change its character; and for this purpose, in the absence of farm-yard manure, nothing but a liberal application of substances which are slowly soluble, such as bones, lime, marl, &c., will produce any sufficiently decided and sufficiently permanent effect. If, however, a field merely appears stunted in its herbage, producing no quantity of grass, a dressing of the mixture of guano and nitrate of soda above mentioned will often produce a striking effect, doubling the quantity of stock that it will carry the very first season. On the other hand, should the land bear coarse strong herbage, which cattle reject, a dressing of compost containing a few bushels of bones per acre—especially if well soaked with liquid manure from a cattle-yard—will bring clover and fine herbage, and make the cattle graze it to the very roots of the grass.

In conclusion, I would state my decided conviction, the result of twenty years' experience, that money judiciously laid out in the improvement of grass-land brings in a more certain return than when expended in the growth of corn. It is not, as in that case, liable to great injury from an unfavourable seed-time, from severe winters, from wet harvests, and the various minor visitations to which grain-crops are subject; and if in a very growing season more grass is produced than the cattle can consume, it is always possible to convert it into an additional haystack—a piece of furniture which, however bulky, is never found to incommode the cattle in their winter-quarters.

Kirby Hall, July, 1858.

XIII.—*Recent Improvements in Norfolk Farming.* By Clare Sewell Read.

Fifteen years ago the Royal Agricultural Society offered its 50*l.* prize for the best Report on Norfolk Farming. Probably few unconnected with the county remember the circumstances of its adjudication. It was justly awarded to Mr. R. N. Bacon, for a Report, whose length, correctness of detail, and valuable statistical information, were never equalled in any similar essay furnished to the Society. It was so voluminous that but little of the matter could have appeared in the Journal at one time, and the author obtained permission to publish his Report in a separate form. This was certainly an unfortunate arrangement for the members of the Society. Instead of the essay appearing in the Journal by thousands, the circulation of the Report was confined to some hundred copies, and did not extend far beyond the county of Norfolk. The fact that Mr. Bacon's Report fills more than 400 pages of a large octavo volume will furnish some idea of the extent and completeness of the work.

The Society, in order that its members should see some account of Norfolk agriculture, printed the unsuccessful essay, written by Mr. Barugh Almack of London. This was a concise and readable Report, giving in a condensed form a large amount of practical information, and containing a very good description of the general state of Norfolk farming. This essay appeared in the fifth volume of the Royal Agricultural Society's Journal.

The writer of these remarks feels much gratified at being requested to compile a few notes on the improvements which have taken place in Norfolk farming since these Reports appeared, and his absence from his native county from 1847 to 1855 may constitute him a better judge of the progress of its agriculture than if he had been a constant resident in Norfolk during that period.

In endeavouring to sketch this progression, many improvements may be noticed that are common to the kingdom at large. This of course cannot be avoided, and it is hoped that the mention of them will not be construed into any desire to confine the credit of such improvements to the county of Norfolk.

The different soils of the county may be ranged under five heads. First in extent and importance is that part of West Norfolk which rests on the upper chalk—a naturally weak soil, but which, by good husbandry, has been made to produce abundant crops. 2ndly, That large tract of blowing sand which comprises a great portion of the south-west of the county, a district formerly all rabbit-warren and sheep-walk, and which, though much improved, must ever remain poor and comparatively barren

land. 3rdly, There are the stiffer loams of the county, which begin with a broad patch at the south-east corner, and are interspersed over a good part of mid-Norfolk. 4thly, We have the naturally good soils to the north-east of Norwich; and under the 5th and last head must be embraced those diluvial tracts which form the fen-lands of the west and the grass marshes of the east of the county.

It is necessary to make these divisions before the different improvements which have taken place in the last fifteen years can be readily or accurately pointed out. Farming in East Norfolk is quite different from that of the west; and when it is considered that, independently of numerous subdivisions, the soils of the county may be classed under the headings of rich Loams, Clays, Chalks, Sands, Gravels, and Peats, the variety of its agriculture may be at once accounted for. The treatment necessary to grow the luxuriant crops on some parts of the Holkham estate would produce an abundance of nothing but straw if applied to some of the soils of the Blofield hundred; so, before attempting to arrive at the general advance of the county, it may be as well to consider the progress made in each of these five divisions.

As often happens, the greatest improvements have been made on some of the worst land. Naturally fertile soils have produced good rents and have grown good crops for centuries; it is on the lighter description of land that modern agriculture has chiefly progressed, and in Norfolk there are other causes to promote this advance. The land in West Norfolk is chiefly held by large proprietors; in the East there is hardly one estate of any great size. The landlords in West Norfolk let their land at moderate rents, and grant long and liberal leases. The lesser proprietors of East Norfolk farm much of the land themselves, and let their small farms at high rents. To the west, Norfolk is laid out in large fields, and the soil is well adapted for sheep; to the east the enclosures are small, the hedgerow timber abundant, and most of the land not calculated for sheep. This comparison might be carried still further, but enough has been said to show in which part of the county the onward movement is likely to be most conspicuous.

It will perhaps be desirable to consider the improvements which are peculiar to each district separately, and then to glance at such as are general to the whole county, and which may possibly apply to all the well-farmed arable districts of the kingdom. Also it may be as well to review the last division first, and to take the other districts in retrograde rotation, reserving the most important till the last. In this order, the alluvial and fenny districts of Norfolk first present themselves to our notice. As already observed, they form but two tracts of any importance:

that towards the east consisting of the grass marshes which skirt the Yare and the Bure; and that on the west bordering the river Ouse, and forming the Norfolk boundary to the great level of the fens. The marshes to the east are almost all in grass, and are chiefly occupied by large arable farmers, who live at some distance from them, and who find them very useful for stowing away their colts, odd horses, and young stock in the summer. These marshes freshen but will not fatten a bullock, and are pretty sound and dry for sheep. Almost all these grass lands are fed; some few are mown for hay by those occupiers whose home-farms are contiguous. The hay is made in a slovenly manner—cut, turned, cocked, and carted. Hands are sure to be scarce in such an out-of-the-way, off-lying district. One would think that machinery was doubly needed there; but a tedding-machine or horse-rake is hardly to be seen on the whole level.

Although several steamers have been recently built, these marshes are mostly drained by windmills; and though there is no regular system of drainage, the marshes within seven miles of the sea are very seldom flooded. Occasionally the river banks give way, and a flood of salt water rushes in. On such an emergency the old windmills are most inefficient: "after a storm comes a calm," and they often cannot go when most needed. But for ordinary purposes they answer fairly, and drain the land cheaply and well. Higher up the streams the drainage is very indifferent, and some of the land is in consequence almost valueless. A well-planned system of arterial drainage would keep all these lands dry; but although here and there some spirited proprietor may bank in his marsh, drain it, and make it excellent land, there has as yet been but little general improvement to note. Recently the Yarmouth bridge has been rebuilt and its water-way widened. This allows the more rapid egress of the fresh water, but also as readily admits the tides. Floods are, therefore, more frequent on the unsecured lands than formerly, for the water in the river often rises above the highest level of these marshes.

The fenny district of Norfolk, which lies at the south-west corner of the county, may be dismissed in very few words; for though it forms part of Norfolk, its farming properly belongs to Lincolnshire and Cambridgeshire, the great fen counties. Much improvement has taken place on these peaty soils, draining and claying being the most conspicuous. The greater part of the Norfolk fens has, happily, a substratum of clay, the overlying peat varying in thickness from 2 to 20 feet. Even at the latter depth clay is raised to the surface by means of deep trenches. It often happens that the peat, by being weighted and well

drained, is so compressed, that in a few years the clay is nearer the surface, and consequently more accessible for a second dressing. The border lands—those fens which skirt the higher grounds—are more improved than any others, being better situated for the extensive application of clay, marl, chalk, and sometimes sand. Extraordinary dressings of these earths, from one to two and even three hundred loads per acre, are applied, and a rush-growing morass has, by these means and by draining, been speedily converted into a fruitful cornfield. Such dressings may be considered too much at once; but the case is altogether different from that of mineral manures applied to uplands. Here these heavy earths are wanted to consolidate the peat, for some of it is so light that on losing the water it blows away. Any excess of lime the earths may contain, which would be injurious on uplands, can expend itself in converting the superabundance of vegetable matter into fertilizing substances.

Steam drainage is universal in these fens. Some great hits have been made in reclaiming and improving the fens of Norfolk; but quite as many blunders might be recorded. The drainage was begun at the wrong end; instead of attending to the mouth of the river, proprietors were more anxious to throw the water off their own lands. Had the main outfall been properly altered and deepened, thousands of acres, which are now drained by steam, would have had fall enough for a natural drainage. There is an idea prevalent that the fens are now drained too much. Some are; but they are exceptional cases. At Methwold, Feltwell, and Hockham Wilton, there is a poor peat, 18 feet deep, resting not on a clay, but on a running sand. There is really no hope of improving such land. Take the water away, and it grows nothing. With the water standing within six inches of the surface it produces a quantity of rough sub-aquatic grass; but when the food of such herbage is gone, nothing comes in its stead; consequently the money which has been expended to drain the fens of that locality is literally thrown away, and dams have to be made across the mill-dykes to stop back the water. It is the opinion of the best practical farmers that arable fens, when *well clayed* and *well farmed*, cannot be drained too much. On the other hand, to drain a light peaty soil, where no clay, marl, or chalk, can be had, cannot answer. Such land must be left pretty nearly in a state of nature. When the grass appears to want renewing, it is as well to pare and burn it, sow cole-seed, take a crop of oats, and lay it down again. Nothing more should be attempted.

The land to the north-east of Norwich, comprising the hundreds of Blofield, Walsham, Tunstead, Happing, East and West Flegg, is considered the best soil of the county. Blofield has

been termed the garden of Norfolk, more truly from its natural fertility than from its garden-like culture. The soil of this district is a free-working loam, of capital texture and great depth. It is certainly good land, and will produce good crops with very little expense; but it is not the land to bear forcing, nor is its yield of grain in proportion to the quantity of straw it grows. There are certain exceptions to this, and in the dry season of 1845 there was one wonderful field which produced ninety bushels of wheat to the acre. However, being sown with wheat again, it did not yield much above four quarters. A stranger, on looking at a crop of wheat in this district, would probably over-estimate the yield, while on some of the chalky soils of West Norfolk he will guess the return at four bushels below what is grown. There is this important difference between them, that on these good lands crops are grown from the natural produce of the soil; whilst on the chalks expensive artificial means must be resorted to, so that the crop is half bought before it is reaped. The soil of this locality is generally deficient in calcareous matter, and in some parts there is no chalky clay or marl within a long distance. These mineral manures are brought by water-carriage, and some are drawn from pits many miles away.

There is not much improvement to note in this district. It has been well farmed for generations. Perhaps more corn is grown than formerly—the five-course (oats or barley following ley-wheats) being frequently practised. Land of this description ought to bear an extra corn crop; but whether from this or other causes, the stubbles are certainly not cleaner than they were. Perhaps the great quantity of mangold wurtzel now grown may also have something to do with this. This crop is sown in the beginning of May, whereas the old white turnips were not sown before July; so there is less time for cleaning the land than formerly. This district readily produces couch-grass, it being a nice friable soil for its roots to riot in. Another reason for so much being grown is, that some of the stubbles are not ploughed till the spring. Very few sheep are kept, as, when turnips are eaten by them on the land, the barley crop generally lodges; but it is the country for splendid stall-fed oxen and good beef. The store cattle eat the small white turnips and swede-tops on the wheat stubbles by day, and lodge in yards at night. It is contended that the treading of heavy cattle is beneficial to these lands, that it greatly stiffens the straw of future corn-crops, and almost dispenses with the use of clay; so that the foul stubbles are poached and trodden all winter long, and not ploughed up till the turnip-tops are finished. This custom is certainly going out of fashion; and so it ought. Independently of preventing autumn tillage and winter ploughing, the cattle cannot do them-

selves much good, during cold wintry weather, by eating dirty turnip-tops off the miry soil; and as to consolidating the land, surely a clod-crusher would do that as well, and could be applied to any crop just when needed, while no amount of treading can possibly supply the lime, which is the chief value of the marl and clay.* As already stated, almost all the roots are removed from the land and consumed in yards by cattle. These roots are of excellent quality, and are mostly grown without any artificial manure. Each fat bullock receives a large quantity of sliced roots daily, perhaps four bushels or upwards, and is also supplied with cake and meal—linseed-cake being decidedly the favourite artificial food. Some of the marshes supply good hay, and the cattle come in for the best of this. Much of the arable land is enriched by the large quantity of fodder and sedge which the low swampy grounds produce.

The improvements peculiar to the strong lands of Norfolk are not very great. The two principal are a larger extent and better mode of underdraining, and the greater growth of roots, especially of mangold wurtzel. Bush-draining clay soils is a very ancient practice in Norfolk, and though pipes are now mostly used, the old mode still exists. Draining was formerly 2 or 3 feet deep; now the general depth is $3\frac{1}{2}$ feet, or from that to 4 feet. The stiff soils of Norfolk are stiff only by comparison; the clay is not of that wretchedly stubborn nature which is so often found in the midland counties; and though the ploughing is sometimes very tight work for two horses, yet more are never used for ordinary cultivation. After these lands have been under-drained the narrow ridges are made wider, but never entirely dispensed with. Though the land may be levelled and cross-ploughed in the summer months, yet, during winter, the heaviest soils are made up into 12 or 14 furrow ridges. These soils are well adapted for the growth of mangold wurtzel. It can be stored early in the autumn, and the land cleared and ploughed up before the heavy rains of winter set in. The farms on these stiff lands are the smallest in Norfolk, and are not occupied by men of large capital. The produce consists almost entirely of corn and beef; and having hardly any breeding-stock, the pressure of low prices is severely felt. They have, however, more grass-land than the occupiers of lighter soils, and generally keep a small dairy; but the farms are very circumscribed and the rents

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* A moderate percentage of lime is undoubtedly a valuable ingredient in a dressing of clay or marl, but the lime so applied will, like lime applied in the ordinary way, be gradually washed away by rain and want renewal, whereas the clay itself is a permanent addition to the soil, and if applied in sufficient quantity, confers upon a light sand two valuable properties of which it was previously deficient, viz., the power of *retaining moisture* and *retaining manure*.—H. S. THOMPSON.

high, the fields small and badly shaped, the fences crooked and crowded with useless timber, and the pasture lands cold and backward. These are the features of the worst districts; some of a more mixed-soil character present a pleasanter aspect, and are much better farmed. The land naturally requires draining, yet sheep, with good management, are successfully bred and fed on it, and excellent crops of all grain, including some of the best barleys, are produced with wonderful certainty, provided only that they are sown in good time and when the land is in good order.

No part of Norfolk is so wretchedly dreary, so barren and uninteresting, as that sandy district which extends over the greater part of the south-west of the county. Most people now enter Norfolk by the rail, and a poor miserable entrance it is. The railway first touches the county at Brandon, and from thence to Thetford, and almost to Attleborough, the country traversed is little else than a succession of desolate heaths, rabbit-warrens, and sheep-walks. This is apt to give strangers an unfavourable impression of the general quality of the soil and farming of the county. Yet it is not possible to make more of such land than is made; the little it naturally produces is turned to the best account. The sheep-walks, although they look so barren and worthless, are useful appendages to large arable farms, and afford at certain times of the year, and in certain favourable seasons, a great amount of hard but healthy herbage for the large flocks which are the sheet-anchor of the occupiers of these lands. Although these intelligent farmers grow a quantity of corn, their chief concern and the great aim of their management is to supply a succession of provender for their sheep. With the greatest care and clearest foresight this cannot always be attained, and a cold backward spring, or a hot dry summer, renders the cultivation of this district anything but a desirable or enviable employment.

Spring, in this locality, is not often the mild, balmy, enjoyable season of which poets love to sing. The biting north-east winds which mostly prevail forcibly remind one of Siberia, while the horrid sand-drifts, which at times quite darken the air, force the mind to travel southward, and dwell for a moment on the deserts of Arabia. Such land is of course cheaply rented; and during the late depressing times the occupiers of this district fared better than their neighbours on better and dearer soils. Sheep sold well, notwithstanding the low price of corn; and when stock lambs at 5 months old fetch from 25*s.* to 30*s.*, there is no cause for the flockmaster to grumble; yet the ewe flocks have not increased, but rather the contrary. The farmers of this county in former years sold all their lambs in the summer

and autumn; now some few are reserved and fatted as hoggets or shearlings. This of course increases the number of winter sheep, and therefore fewer ewes must be kept; but the fat sheep are disposed of from turnips, thus leaving a better chance for the flocks in the spring. By feeding these young sheep more corn is grown, and it is a pretty general custom with good farmers to give their lambs (at least the twins), some oil-cake as soon as they can eat it. This is one of the chief reasons why stock lambs from this district come out so much better in size and condition than they did in years gone by. A large quantity of rye is sown for sheep feed, and the turnips which follow generally succeed well. But after vetches they seldom thrive. A heavy crop of vetches seems to extract every drop of moisture from this thirsty land, and the turnip plant is invariably a failure. After the rye is finished the sainfoin and other layers, with a run on some of the sheep-walks, furnish food for the flock. These heaths serve for the stowage of the flock after the lambs are weaned, and the ewes do very well in the autumn when feeding on the heather or ling. They are then folded at night, generally on ley ground for wheat. It is not found necessary to give the ewes many turnips before lambing; their condition is maintained as well as it can be by other means, and some dry provender is always given when they are kept entirely on the turnip land. Sainfoin is an invaluable plant in this locality. It does not suffer from drought like clover and other seeds, neither does the plant fail. Mostly it remains but one year, but in some instances it is kept down for four seasons, until the field comes for wheat again. A few years ago this district grew hardly any corn but rye and light oats. Now by sheep-feeding very fair crops of barley are obtained, and by better management that pest of the wheat plant, the poppy or red-weed, is more easily destroyed. The plan now often adopted is to plough the ley early, roll it lightly, and so let it remain for some time. The winter annuals soon show themselves, and when well up harrowing, heavy rolling, and drilling the seed, take place. During the winter it is the custom on many farms to use the lever harrow, or rake, which scratches the land and pulls up much of the red-weed. This is particularly the case in frosty weather, for the poppy, though so hardy when old, is particularly tender in an infant state, and cannot bear this rough usage, or being buried, however lightly, with mould. Then early in the spring, the earlier the better—say in February—the wheats are well hand or horse hoed. It is of no consequence burying the wheat, for that soon grows through, and by this means the red-weed, which is in the rows of wheat, is destroyed. Thus, by eradicating the poppy, consolidating the land, and well manuring it, fair crops of wheat are

raised on a blowing sand, and are less affected by dry seasons than barley or oats.

It may be as well, before leaving these sandy soils, to mention one peculiarity of the farming in the north-east corner of the county. There is much light land in the vicinity of Cromer, which was invariably farmed in a five-course shift, having two years' grass seeds. In the second year the seeds were broken up in July, and made a "bastard summer till," or fallow for wheat. One could imagine no worse preparation for wheat on such lands. The ground could not be consolidated, and every facility was given for the swarms of winter annuals which infest such soils to spring up and smother the plant. The farm manure was wanted for turnips, and a one-year ley, left to its own resources, grew but little wheat. Under the present system artificials are used extensively for the root-crop, and as the soil is naturally kind for a plant, pretty good turnips are raised. The farm manure is thus set at liberty for the wheat, and a one-year ley, when well dressed and once ploughed, will produce a fair crop of corn.

Fir belts have recently been planted across many of the open sandy districts of Norfolk. These rapidly grow up and break the force of the wind, which is here one of the farmer's worst enemies. The fences, too, of Scotch fir and spruce, make capital shelter. They will grow where whitethorn will not flourish, and if well cared for at first and kept properly trimmed, soon make a strong, pretty, and durable fence.

We now come to the field of the greatest improvement—the light chalky soils of the west—that portion of the county which is commonly regarded as the true type of modern Norfolk farming. It is just the district for this expensive style of agriculture. The soil is naturally weak, and if farmed badly will ruin any man. It is nice working, friable land, has a good dry subsoil, abounds in calcareous matter, is healthy for sheep, and will bear forcing and top-dressing. The wonderful strides which this district made between the times of Young's and Bacon's Reports must be fresh in the mind of every British farmer. It will be quite unnecessary to go over the history of that progression, or enlarge on the wonderful changes it produced. It is the object of these few remarks to take up the story where Mr. Bacon left off some 15 years ago. Perhaps it will be best as well as easiest to touch upon the alterations and improvements in the order in which they strike the eye in overlooking the district.

Foremost in this order of the eye, though not in real importance, is the alteration in the fences. West Norfolk had always good large fields, but the fences were great masses of whitethorn some 8 or 12 feet high. These were cut off at stated periods,

and the banks properly made up and the ditches scoured out. The high fence was regarded as affording capital shelter in that open district, though loss of crops on the headlands told that such shelter was dearly purchased. As it is nearly all arable land, the shelter to stock can be of little value. Sheep feed off the turnips in folds, and on a cold night are as likely to be in the middle of the field as near the fence; and though they may have more liberty on the grass lands in summer, they deposit the manure where it is not needed if they seek the shade or shelter of the fences. To ewes and lambs these high mounds certainly were of some service in our cold bleak springs, but closely-made wicker hurdles, and other temporary means of shelter, are more conveniently multiplied than these high fences. There has been a wonderful change lately. Instead of those great mounds of whitethorn, neat little lines of fences are seen all over the district. The soil, being dry, requires no ditches; these have been levelled in, and the high banks reformed, some of the mould carted away, and the turf replaced. The old fences when cut down are not all chopped off close to the bottom as formerly, but large stubs are left from 6 inches to 3 feet high, and some long pieces are braided across the weak spots. Each cut is given upwards, so that no stake which is left is splintered. The fence is trimmed every year with a long-handled hook or scimitar, and is allowed to grow 4 feet high. It is perfectly sharp at the top, and about 3 feet wide at the bottom. Such is the theory, but, like many other new practices, it cannot be regularly carried out on all farms. First, then, on thin soils these little whitethorn fences cannot bear this annual trimming. Now and then they want rest, and once in four years they should be permitted to run wild. The best time is when the field is a layer, as it prevents the sheep from browsing into the fences so much, and there is no danger of the trimmings making them lame, which is sure to be the case be they ever so carefully collected. On very cold and exposed sites the 3 feet fences are too thin; the cutting winds blow through and destroy them. They should be at least 4 feet thick at the bottom, and formed after the fashion of a pyramid, care being taken to make the fence lap well over the back of the bank and to cut the face (or ditch side) closely up. With such little variations from the general rule, hedges of this kind are likely to stand many years, will make strong and capital fences, present a neat appearance, and do no harm to the growing crops.

The next observable improvement is one of far greater moment. It is the increased productiveness of the wheat crop. Competent authorities assert that this district now grows *a quarter of wheat more per acre* than it did 15 years ago. Formerly all the

manure that could be made on the farm was needed for turnips; now a great breadth of roots is grown with artificials, leaving a large portion of the farm manure to be applied for wheat. It is placed on the ley-ground directly the hay is off or before the land is ploughed for wheat in the autumn. The flag is firmly consolidated by wheel-pressers, drill-rollers, or the like implements, and the wheat is invariably drilled across the furrow. In the spring it is a common practice to top-dress the wheat with nitrate of soda and salt; and as this custom has become general, it is a proof that it is successful. An account of experiments, which have been conducted for many years with great care and skill on the Holkham Park Farm, will be found at the end of this paper, and the aggregate result of such a long and varied trial cannot be otherwise than important. Suffice it to say, that nitrate of soda is greatly preferred as a top-dressing to guano, for, while one takes no sort of harm from the cold dry winds, the other loses much of its virtue when so exposed.

Another striking feature is the great extent of wheat which is now grown. A few years ago hardly any was sown after a root-crop, but it is now almost universal to plant wheat after mangolds, and to sow a large portion of the turnip-land with it as well. The reasons for this change are—that wheat will bear high farming better than barley, is not so liable to be affected by unpropitious seasons, and on some soils will produce as much per acre. There is also another advantage—that the clovers, trefoils, and sainfoins, but especially the latter, grow much better with wheat than with barley. The wheat seldom lodges, its straw is stiffer, grows more upright, and readily admits the air. Having been planted some time before the seeds are sown, there is a firm seed-bed, with enough fine mould to cover them, without burying them too deeply, as is frequently the case when sown on well-pulverized barley land.

One great and increasing agricultural evil in West Norfolk, and, indeed, all over the county, is the clover sickness. In the four-course system it was common to sow clover once in eight years, and trefoil, white clover, rye-grass, &c., when the land came round for seeds next time. Now it is found that the clover plant fails, and cannot be relied on even once in eight years. It is not the country for growing beans or even peas, but in lieu of repeating the clover so frequently sainfoin is grown instead. The quantity of sainfoin seems annually on the increase. In 1843 this plant was confined to the light sheep districts, and was not then grown in rotation, but a few spots were planted with it and kept down as long as it would pay. Now the sainfoin ley is taken up at Michaelmas for wheat just as clover would be, and it is a capital preparation for that grain, better even than

good clover-ley. It is an expensive seed, as from 3 to 4 bushels of sainfoin are *drilled* to the acre, and frequently a quarter of a peck of trefoil is sown broadcast in addition. So its cost is hardly ever less than 1*l.* per acre. When sainfoin is to remain only one year the giant is considered the best variety; it comes quicker and throws out more food in the first season than the common sort.

By substituting sainfoin for trefoil, surer crops of red clover are grown. One reason for this may be the *total absence of any sort of clover for eight years.* When trefoil was sown it was the invariable custom, in addition to the peck of that seed, to add 4 lbs. of white or Dutch clover, which produced nice sheep feed after the trefoil had expended itself, and also contributed to make a good flag for the wheat. But white clover is of the same family as the red, so it eats up that mysterious morsel which an eight years' rest should have husbanded for its more fastidious brother.

The yield of barley has not perceptibly increased; the maximum amount appears to have been grown some years ago; sheep were then cake fed, and turnips sliced for them; and as much of the farm manure, with which the roots were grown, remained unexhausted, very great crops of barley were produced: but this grain will not bear more forcing; even now too much stimulant is frequently applied, the crop lodges, destroys its own quality, and kills the grass seeds. An enormous amount of artificial manure is used in this part of the county for growing roots and grain; not unfrequently the manure agent's "little bill" is more than the landlord's rent. In the time of Mr. Bacon's Report, rape-cake, bones, and the newly discovered guano were almost the only artificials known; since then superphosphate has superseded all these in the production of turnips. For mangold the favourite dressing in addition to yard manure is guano and salt, and some still prefer guano for swedes; but by far the greater portion of the farmers of West Norfolk use superphosphate. The common mode of growing swedes is to apply six or eight loads of good farmyard dung per acre, and drill 2 or 3 cwt. of superphosphate with the seed. Almost all roots are planted on balks or ridges 27 inches wide. Very few white turnips are sown, but the growth of mangold-wurtzel has wonderfully increased.

In the live-stock department the most prominent change of this district appears to be in the breeding flocks; almost all have been sensibly diminished, and on very many farms they have been entirely given up: this cannot be on the score that rearing lambs is unproductive, but there is great difficulty in providing spring provender for the ewes and their offspring, and late

turnips and late barley do not suit this country, nor do high farming and a breeding flock very often agree, consequently more sheep are grazed and fewer bred than formerly. The fattening of sheep has been long and well practised in West Norfolk. Gardiner's turnip-cutter is still almost the only one used. The roots thus sliced are given in open troughs, while in the covered ones oilcake and hay-chaff are supplied; but little corn is given to sheep. The labour of this mode of feeding is not very expensive; two lads, or a man and a boy, will attend to ten or fifteen score; that is, they will trim and heap the turnips, set the fold, and feed the sheep: the usual cost is considered to be about 1*s.* per score per week. Seldom more than one-third, frequently not so much, of the turnip crop is removed from the field for the bullocks: the rest of the roots being left for the sheep, are placed in rows and partially covered with mould. A great number of extraordinarily good hoggets, or yearling sheep, are turned out from this district in March and April. One advantage of this system is that the flock-master finds it his interest to give a little oilcake to his lambs, which not only improves their condition, but also increases the produce of his poor farm. The lambs so treated in their infancy receive a liberal allowance of cake when they are fed on the seeds in their new home, so that when they go to turnips early in the autumn they are in famous order and better able to stand high feeding during the winter months.

Another noticeable alteration has taken place in the ploughing on some farms of West Norfolk; it is by no means general, yet is rather extensively adopted when ploughing ley ground for wheat where the lands are perfectly dry. The field instead of being cut out into ridges is ploughed *round.* On the previous day one plough goes and turns off the corners; then a number follow each other round and round the field, and there is but one furrow in the middle of the enclosure; by this means a great amount of ground is ploughed in a day, no time is lost in turning, and there are no furrows to interfere with the drill, the horsehoe, or the operations of harvest. When the field is again ploughed, of course it is commenced in the middle, the ploughs making the only furrow into a top, and finishing off by the fences. There is another peculiarity on some few occupations in this district, which is that scarifiers have almost superseded ploughs. On some farms of great extent Coleman's cultivators are used entirely for cleaning fallows, and no plough comes into the field till the one with double mouldboards ridges up the land for the manure.

The most prominent features of the several districts have now been touched on; it remains to glance at those changes and

improvements which are more or less applicable to the whole of the county, and which in a wider sense form part of the agricultural progress of the United Kingdom. But where to begin? Of all the novelties of the last fifteen years, which has created the greatest revolution in agriculture? Perhaps artificial manures. Well, what troubles us most frequently does us the greatest good; let us hope it is so with artificial manures. There are always two ways, a right way and a wrong one, and most frequently the wrong comes first. Ah! but with artificial manures not only does the disagreeable way take precedence, but there are many wrong ways, and only one that will guide us right. We try all sorts of manures, for all sorts of purposes. Some is purchased because it is cheap; some to serve a needy friend, some because the agent is a respectable man, some because it is horrid-looking stuff, some because it has a most revolting odour; and there are many other reasons too numerous and too absurd to mention. Now all these ways are wrong ways. The right one is to *buy only by analysis.* Science may have made its false steps, Lawes and Liebig may have differed, abstract theories may not always have borne practical fruits, but still chemical knowledge is the only way by which we can arrive at the real value of these artificial manures. Our practical ignorance cannot be bliss, unless it be pleasant to buy things at double their value, and lose good crops into the bargain. Farmers begin to see this, and a more healthy and rational feeling is coming over the manure market. A price being put on the most valuable parts of the manures, a buyer by analysis can readily see what his manure should cost, and a fee of 10*s.* to the Society's chemist will soon let him know if the bulk equals the analysed sample. The transactions in artificial manures have been long in coming to this simple plan, but once established, the ignorant manufacturer who unintentionally fleeces his customers, and the rogue who purposely adulterates his manure, may consider their occupations to be gone.

Guano is extensively used in West Norfolk for wheat. It is usually ploughed in in the autumn, yet by some it is still applied as a top-dressing in the spring. As at that season much of its efficacy depends on the weather, the use of guano, unless it can be incorporated with the soil, seems on the decline. Guano is applied largely for barley and oats on light land, being generally harrowed in before the seed is drilled. It is fashionable to use a mixture of guano and superphosphate for barley, and these fertilizers are considered the base of the various barley manures which inundate the market. Of course if nothing else were added they could not be sold for 8*l.* or 9*l.* per ton. The principal addition is frequently salt—a useful and cheap substitute for more valuable manures. The sale of guano has much

declined during the last few years in consequence of its high price. Comparatively little is now used for turnips; and if the present value of grain be not enhanced, farmers will leave off buying guano at 15*l*. per ton as long as they continue to sell wheat at 5*s*. per bushel.

The quantity of salt now used in Norfolk is considerable. The railways have opened the communication with the great salt-works, and there is a good demand for salt, though the price has lately advanced 3*s*. or 4*s*. per ton. It is applied generally in conjunction with guano, at the rate of from 3 to 5 cwt. per acre for mangolds, being sown on the farmyard manure before the ridges or balks are split back. It certainly very much increases both the weight and quality of mangolds, and on light lands appears in seasons of drought to absorb moisture from the atmosphere, or else retain what is in the land. Salt is also extensively used with all sorts of top-dressings, as it tends to strengthen the straw, and brighten the sample of the grain. Much is likewise employed to destroy the vitality of couch and other weeds; and by some farmers it is mixed with the farmyard manure when packed over in the fields. Yarmouth supplies a great quantity of fishery salt in the herring season; the scales of the herring, as well as all the injured and refuse fish, are mixed with the salt, and sold at about 40*s*. per ton. Its value very much depends on the quantity of fish-refuse that is added to the salt. The weight of this addition is generally small, and frequently there is a mixture of what is not much needed in Norfolk, viz. common sand.

Bones have given way to superphosphate, save that some large farmers buy bones and dissolve them with acid, or decompose them by fermentation. The effect of good superphosphate on the turnip plant is indeed wonderful. Some parts of Norfolk—particularly the white malmy soils—were unkind for turnips. Formerly a good plant on such land was the exception—now it is the invariable rule, and splendid crops of swedes are now grown with certainty, where before only a tiny crop of white turnips was ever expected. On the lighter soils, too, this artificial manure has done wonders. In days gone by rape-cake was the only auxiliary the farmer could command. It was a good sound fertiliser, but not well suited for the tender plant, although excellent for its later growth. Now a little superphosphate is used to start the plant, and hurry it out of the way of the fly. By these and like means, the weight of roots grown on the poor light lands of Norfolk is wonderfully increased.

Who shall tell of the nameless and numberless manures which now exist? The task would be uninteresting, and the result unprofitable. Numbers of these wonderful productions have

bubbled up and burst, their memory only existing in the breast of some unfortunate farmer, who lost his crop by inadvertently purchasing some great bargain. To enlarge on this matter would be to attempt a treatise on artificial manures rather than to relate the advance which they have caused in Norfolk agriculture.

It is time to turn to another subject—one of very great importance—one about which there has been less mystification, on account of its being more generally understood. The progress in *agricultural implements and machinery* is very marked. Foremost in the rank of improvements must be placed steam-thrashing. When Mr. Bacon wrote his Report there was only one portable steam-engine in Norfolk—now there are nearly as many engines as there are parishes. This is a great and rapid increase, for anything new does not often take readily with agriculturists. It is worthy of remark, to show how durable well-made portable engines are, that the one mentioned by Mr. Bacon is still in existence, and works as well as ever. Horse-machines had established their superiority over the flail, and they have had to bow before the giant power of steam. There are very few occupations in Norfolk well suited for fixed engines. All the large farms have field-barns, to avoid the necessity for carrying the whole of the corn to the homestead. Therefore portable engines, which can be removed from one steading to another, and from one stack to the next, are more suited to our county. There has been a great saving in the cost of thrashing wheat by steam—not so great as some statements would make out, for it cannot now be done with portable engines under 1*s.* per coomb (2*s.* per quarter); but still the cost is only half what it was. Independently of the saving of expenditure, the crops of wheat now grown could not have been thrashed by flails, and there is the opportunity of taking advantage of dear markets, by knocking out any quantity in a very short time. Had there been no steamers last harvest, the price of wheat must have considerably advanced before the new crop could have been delivered in the old way. In East Norfolk the flail is still occasionally used for barley. The farms are smaller, and labourers more plentiful: they have thrashed the crop this year at from 1*s.* 8*d.* to 2*s.* per quarter; so there is really little gain from using steam for barley on these small occupations, as long as this sort of employment is needed for the labourers. But it is quite a different question in the West; there is hardly a flail in the parish, and that is only brought out from its hiding-place to thrash the gleaners' corn. The horse-machines are mostly broken up and sold, or the horse-works used for chaff-cutters, so totally has steam destroyed all competition. Steam-thrashing has enabled the farmer to dispense with some horses, or, if not, to employ them more advantageously about his farm. There

are not above a dozen fixed agricultural steam-engines in Norfolk. Wherever they are placed, other machinery, such as chaff-cutters, mills, corn-bruisers, and the like, are driven by the engine.

Norfolk is not a county that requires much art or great strength to plough it. The old-fashioned plough, with its fore-carriage and rampant beam, is still in general use, but improvements have been effected in the shape of its mouldboard and other wearing parts. Even into this light-land county, however, the modern iron ploughs are finding their way; slowly perhaps, but surely. Mr. Bacon supplied a list of the implement-makers connected with the county, and of those who furnished it with the best implements. The names of the great plough-makers of Bedford were not in that list; yet within the last fifteen years that celebrated firm has sent into Norfolk more than 1200 ploughs. And it may be remarked that almost the whole of the number have been supplied since 1848. The Royal Agricultural Society held its meeting at Norwich, in 1849, and the prize for light-land ploughs went to Bedford. This is one little proof of the efficacy of the Society's itinerant encampments in introducing good machines to a county, and shows the benefit derived by successful exhibitors from having special attention directed to their implements.

Drills have long been in favour in Norfolk, and in no other county is drilling better done. The men have a great deal of practice, as all corn is now drilled; and there is no mode of steerage so perfect or so handy as the old back-steerage of the Norfolk drills. Water-drills have not yet taken very extensively, chiefly on account of the scarcity of water on the large farms. But the Holkham experiments go far to prove that great benefit results from its use, and no amount of ashes can distribute concentrated manures so easily and well as does the water from Chandler's drills. A great improvement in the water-drill has recently been introduced by a West Norfolk farmer; the water, seed, and manure being dropped together in bunches, by which means all are economised. The same individual is also the inventor and patentee of the celebrated manure distributor which bears his name, and almost every large farmer in West Norfolk, who uses much artificial manure, has one of these machines. It is quite impossible for any man to sow guano by hand with regularity, and there are other valuable manures that require to be distributed with great exactness, which this machine does to a nicety.

During the last year some of M'Cormick's reaping machines have appeared in Norfolk. Previously one or two of Hussey's had been used, but their number did not increase. The former won golden opinions last harvest, and the makers have in consequence received extensive orders from our county. Norfolk farmers ap-

pear rather slow in adopting new and improved implements. They do not largely patronise a novelty until its merits are pretty well appreciated elsewhere: and if any implement is in good repute in Norfolk it may be considered to have perfectly established its character for utility and durability. But because it does not succeed at first, it by no means follows that the invention is worthless. Norfolk is the best county for testing any new manure, or fresh feeding-stuff; but considering the advance of its agriculture, it is the worst starting-place for any novel implement. To account for this it may be observed that the old Norfolk implements were good in principle, much a-head of the times in which they were invented, and admirably suited for the light soils of the county. The labourers have used them so long and so well, that it is a difficult matter to make them take to any new implement, and the masters, being satisfied with the good work of their old machines, are not disposed to invest much money in new ones. Some of the drills which were made 40 years ago are still used on the Holkham estate, and the wonder is that machines so ancient and dilapidated can make such straight and regular work. In other parts of the kingdom in which drilling is not so well understood, their appearance would at once condemn them. One-horse carts are not extensively used; waggons are still the favourites, though they are not so light and elegant in make as those of the midland counties. A sort of hybrid carriage, having the form of the Berkshire waggon, with all the Norfolk conveniences for locking, has become general on some of the best farms of the west. Last year there were two exhibitions of steam-ploughing in Norfolk; the traction engine performed near Thetford, and the stationary one in Holkham Park. Neither of them convinced the spectators that steam was *yet* an economical substitute for horse ploughing, but the verdict of the Norfolk farmers was decidedly in favour of the stationary engine and its wire ropes.

There is still a class of modern implements which has not been mentioned, viz. the combined parers, cultivators, and grubbers. In olden time Norfolk had some capital scarifiers; some of them are still in use; but these cheap and efficient implements were intended only to work in loose land, which they stirred well, bringing the root-weeds to the surface. They did not pretend to pare or break up stubbles, or to move all the ground. Biddell's great implement first came forth for this purpose, and answered famously, with the exception that it required too much horse-power. Subsequently Bentall's broadshare rose into notice, and was patronized by many farmers; but recently Coleman's scarifier has appeared, and is decidedly the best implement of the kind, and the one most used in Norfolk. Its

chief fault is its great price, which, considering the present cost of iron, is really too high, notwithstanding all that can be said about its good workmanship; and even this is by no means faultless. Now these scarifiers, if they did not introduce, have perfected a new feature in Norfolk agriculture. Autumnal cultivation was certainly attempted in times gone by; the land was skeleton-ploughed (that is, ploughed with the common plough deprived of its mouldboard), first one way, and then the other; harrowed, rolled, and so forth. By these means a small portion of the stubble was cleared after harvest, perhaps enough for the small breadth of mangold then grown. But the operation was slow, and the ploughs often stirred the land unevenly, and too deeply, so that the harrows could not drag out all the grass. Now it is not uncommon, after an early harvest, to see all the fallows thoroughly cleaned before Christmas, so as to want but little ploughing in the spring. Several farms were visited this winter with the view of collecting materials for this Report. The dry weather enabled many farmers to give their fallows the second earth early in the spring; and the winter furrow, on being run back, turned up the soil as clean and well pulverised as the most fastidious gardener could desire. When these *light lands* of Norfolk are clean, autumnal cultivation does more harm than good. They are sufficiently friable by nature, and do not want to be finely pulverised or constantly stirred, as the heavy winter rains then wash more of the manure into the porous subsoil. So the best farmers do not stir their *clean* stubble in the autumn, but give them a good winter ploughing some time before Christmas, and thus grow better turnips than where the soil has been well cultivated after harvest. Notice has already been taken of the extended use to which Coleman's scarifiers are applied on some farms. These are, of course, exceptions, but they commonly save a great many ploughings, being used largely for stirring strong soils for barley in the spring and in the after preparation for the root-crop. The idea has at last become very prevalent even in Norfolk, that, if the land is clean, the constant inversion of it, by repeated ploughings in the spring, is unnecessary. There can be no doubt of the truth of this on light lands. The sun is not required to extract every particle of moisture before the turnips are planted, but a good, deep, and finely pulverized seed-bed can be obtained by the scarifiers, and the moisture still retained.

The very commendable practice of forking out couch in the stubbles, directly after harvest, is fast increasing. The little cast-steel forks are famous for that purpose, and a gang of women or boys will go over many acres in a day. The cost varies from 1*s*. to 5*s*. per acre; and if the land is too foul to be

forked at that price, then it is cheaper to clean it by horse-power. A little knot of couch, if pounced on as soon as the corn is off, is easily removed from the soil by a fork; but if it is raised by a scarifier, and torn into shreds by the harrow, it may be carried over half an acre, and will become difficult to collect. Forking between the drills of turnips is also a capital plan: notwithstanding all the farmer's care, in some wet seasons a bit or two of couch will escape the campaign of the fallows, and flourish among the fine mould and rich manures of the root-crop. The use of the fork in such a case is invaluable, and as soon as the turnip-leaves begin to fall in autumn, it is a common practice to have the ground overlooked, that the couch and other root-weeds may be forked out, and the land rendered perfectly clean.

The Norfolk, or four-course, shift is going out of favour in its native county. At any rate it is not so rigidly adhered to as formerly. For many years two white-straw crops in succession have been taken in some of the good deep soils of East Norfolk, but, until recently, such a deviation from the established rule was considered bad farming in the West. The very mention of such a thing was a perfect shock to some landlords. But what is the use of artificial food and manures, of new implements, of extra capital, and of all our recent improvements, if we cannot grow more corn, ay, and grow it more frequently too? Already the land is stimulated to such an extent that it is dangerous to force it further, unless some means be discovered to keep the straw from lodging. As it seems impossible to grow more corn in one year with any certainty, the next step is to grow it in more frequent rotation. As long as a tenant keeps his land clean and in good heart, the conditions of good farming are complied with, even if an extra white-straw crop be taken. Even on the Holkham estate—that fostering parent and stanch supporter of the four-course rotation—the tenants are allowed to grow as many oats on their wheat-stubbles as they consume on the farm. In order to show that these extra crops can be grown without in any way injuring the fertility of the soil, a field of oats, which in 1856 attracted much notice at Castle Acre, is brought forward as a successful instance. The field in question contains 46 acres, and soon after the harvest of 1855 the little couch-grass that was in the wheat-stubble was forked out. During the winter turnip-tops, &c., were thrown on the land for the ewes, which were removed at night, and in February the field was regularly folded over with 2000 sheep, eating 5 tons of mangolds per acre and ½ lb. of oil-cake each per day. The ground was then ploughed, and 2 cwt. of guano an acre sown on the weakest portion of the field; white Tartarian oats were drilled in March, and were afterwards top-dressed with 1 cwt. of nitrate of soda and 2 of common salt. The

result was one of the most level and glorious crops of grain ever seen in Norfolk. The yield of oats was nearly 15 quarters to the acre, and the field on being cleared was as clean as a garden. Last year the same field produced the *best crop of swedes in the county*, and the barley which follows now shows signs of *over-luxuriance*. This is the perfection of farming: to grow such excellent and profitable crops, and yet keep the land free from weeds and increasing in fertility. The usual mode of growing such oats is to clean the wheat-stubbles directly after harvest, and to sow 2 cwt. of guano before the oats are drilled in the spring. A top-dressing of nitrate of soda is often added, for oats will stand plenty of manuring, and the grain, if the crop lodge, is not necessarily spoiled. It is the general practice to take oats after wheat, but it is questionable if barley is not a better grain to grow as a second corn-crop. The quality of wheat-stubble barley is invariably finer than that of the turnip-lands, and oats could be grown after the late swedes when the sheep had consumed an extra quantity of cake, and the land was in too rich a condition to be safe for barley.

Talking of these corn-crops reminds one of the harvest, which in Norfolk is generally of shorter duration than in most other counties. The usual mode is to employ a certain number of men, boys, and women to secure the crops, the former of whom are paid a fixed sum per head, be the time they are about it long or short. It naturally follows that these men exert themselves to finish off the harvest in good time: it rarely extends beyond a month, and is frequently less than three weeks, and the men have of late years received 6*l.* for their harvest wages. All the corn is cut with the scythe, and the cost to the farmer for securing his crops is from 10*s.* to 13*s.* per acre, which includes thatching, beer, and all other expenses. The practice of putting out corn by the acre is gaining ground in the south-west, and is common in the fens. The introduction of reaping-machines may probably work quite a revolution in harvest operations and in the mode of paying the labourers.

Norfolk will always be more of a grazing than of a breeding county. Hardly any cattle are reared; almost all the vast number of beasts which are grazed every winter are bought in store condition on Norwich Hill, or at the various markets and fairs in the county. The Galloway Scots, which many years ago formed the chief supply, are now very inferior in quality and few in quantity; all the best are grazed north of the Tweed, and a few refuse things that will neither grow nor fatten find their way to Norfolk. St. Faith's fair is the only occasion on which many good Scots are offered. The quality of the short-horns, but especially of the Irish cattle, has wonderfully improved; indeed,

the latter bear but a very slight resemblance to the original long-horned breed of the Emerald Isle. By judicious crosses with the short-horns some very useful cattle are produced, showing much of the quality of the new blood, yet retaining a great deal of the flesh and frame of the old stock. Fearful losses continue to result from the attacks of pleuro-pneumonia; they amount to fully 5 per cent. on the cattle that are purchased, which of course makes grazing a still more precarious and losing concern. The young Irish cattle are particularly liable to this disease, the voyage and long journey appearing to predispose them to its attacks. A few good herds of pure bred short-horns are seen in different parts of the county, and some little attention has recently been paid to the red-polled breed, which are the original Norfolk cattle. The Devons, which were introduced by the late Earl of Leicester, still flourish at Holkham, where there is some of the best blood in the kingdom, but there is only one tenant on the estate who keeps up a Devon dairy, the other herds having gradually dwindled away. It has been recently the custom with some farmers to buy young calves or yearlings from the midland counties, and rear and graze them. But where there is so little pasture-land, and so much difficulty in procuring well-bred calves, the system is not likely to extend, although anything which tends to keep the price of store stock within reasonable limits, and so reduce the grazier's expenses, is sure to be highly appreciated in Norfolk. The quantity of roots which grazing cattle receive is much greater in the East than the West. In the latter, two-thirds, three-fourths, or all the turnips, are consumed on the land by sheep, and therefore very few can be spared for the yards; but as the straw must be made into manure, a number of cattle are kept, which receive a large quantity of artificial food and a few roots. As a greater extent of corn is grown now that extra crops are taken, the quantity of straw increases and the number of acres of turnips diminishes; so cattle must be kept more than ever upon artificial food, if the straw is to be converted into valuable manure. In the East it is quite different; the greater portion of the roots is taken to the grazing-yards, and stock are allowed to partake of them *ad libitum.* The quality also of the roots is so good that a much less quantity of cake or meal is needed.

The old-fashioned way of slicing roots has been much invaded lately by the introduction of pulpers. Where but few roots are given, it certainly economizes them; and when equally distributed over the whole mass of provender, cattle cannot pick out one kind of food and refuse another. For all store stock it is an admirable plan. By mixing the watery roots with large quantities of dry chaff, cattle will eat an amount of straw which they would

otherwise refuse, and a certain bulk of food is necessary to promote digestion. The pulpers came into use very rapidly, but they are not now so much used for fattening cattle; they answer well when cattle are hungry and hearty, but when they become fat and fanciful it is better to give the food separately, as the variety pleases them more than having the same mixed mess always offered them. Such is the opinion of most graziers who have been pulping roots for fat stock, but there are a few who adhere to the new plan throughout, and there are also some old-fashioned farmers who would on no account be guilty of mincing roots, and think cattle can never flourish unless they can have five or six bushels of swedes a day.

Oilcake continues to be the predominant and favourite feeding-stuff with the Norfolk grazier; no matter how dear it may be, he will have it. Of all artificial food it is certainly the most handy in form, the easiest to keep, the most palatable to cattle, and the safest when given in large quantities. But still it is questionable if it be good economy to use it so extensively, especially when beans, wheat, and other grain are low. A certain portion may be desirable, but, instead of giving so much linseed-cake, it would be better policy to use a mixture of artificial food. A year or two ago, when keep was very scarce and *treacle* very cheap, that article was extensively used as food for stock. It was given principally to store stock. A pound or so per head was diluted in a quantity of water, and then mixed with cut straw. The chaff was thus sweetened by the treacle, and the cattle eat it readily, and kept themselves in fair condition. Treacle was at that time 15*l.* per ton; the following year it rose to 24*l.*, and, as provender was more plentiful, the use of it for feeding purposes speedily ceased. The price of it is again reduced to 15*l.*, but there is now hardly any demand for it even at that low figure. The pod of the *locust-bean* was introduced at a moderate price, which subsequently became so enhanced that its consumption rapidly declined. The last new artificial food is *cotton-cake.* This has been extensively given to store stock during the past winter. That made with the husk is mostly sold; its price has varied from 5*l.* to 6*l.* per ton. The yellow cake, which is made from the seed alone, is very dear, and has not much consumption in Norfolk.* Stock eat the common cotton-cake readily and thrive upon it, but it is not greatly in favour for grazing. *Rape-cake* is still only partially used. Some farmers consume a large quantity, giving it principally to sheep; others, after one or two

* The cake made from the kernels of the cotton-seed, after the removal of the shell or husk, is known to the trade by the name of "decorticated cotton cake," and may be bought in Liverpool at from 6*l.* to 7*l.* per ton. At this price it is a valuable addition to our list of feeding-stuffs.—H. S. T.

trials, give it up. Much depends upon the quality of cake purchased, for some is so gritty and bitter that the cattle refuse it.

The old Norfolk sheep are almost extinct. A few may still be seen in some parks of the county, where they are kept after the manner of deer, and not killed till they are four years old. Perhaps in a little time specimens of the Norfolk ram, with his long black face and great curling horns, will only be found in the Zoological Gardens or some travelling menagerie. But though the pure-bred Norfolk is never seen, traces of the old blood are to be found in more than half the flocks of the county. The qualities of the breed which are perpetuated are not to be despised. They impart a great frame, hardihood, strength of constitution, and wonderful milking properties to the ewes of the flock. But few of these black-faced ewes are bred in the county. They come principally from Suffolk, being purchased by the Norfolk men as hoggets or shearlings. The style of ewe now bred is a very much better animal than it was in 1843. By a judicious admixture of Down blood, earlier maturity, more wool, and better-shaped sheep have been produced; the credit is not due to Norfolk, but belongs chiefly to our southern neighbours. Some flocks of Hampshire and South Down sheep are kept, but not many of these ewes are bred in the county, being imported from the Sussex and Hampshire fairs, generally as full-mouthed sheep. A few Shropshire Downs have recently come much into notice. One flock in particular produces some extraordinary sheep. These are bred from Cotswold sires, and 400 of them, when under 15 months old, were sold last year in London at from 56*s.* to 75*s.* each, and their fleeces averaged as much as $10\frac{3}{4}$ lbs. This season, the shearlings of the same flock are in splendid order, competent judges computing their average weight at upwards of 25 lbs. a quarter. Almost all the sheep reared in Norfolk are half-breds. The ewe flocks have been described, and the rams used are principally long-wools; some of the most useful having a mixture of Leicester and Cotswold blood. Formerly pure Leicesters were much used, but South Down and Leicester blood produce too small a frame, though the sheep fatten readily. Some half-dozen men in the county breed a great many long-woolled rams, and let or sell them at their annual auctions. The sheep at West Dereham, Westacre, Marham, and Hempton are largely and most deservedly patronised. Shearling rams let at from 5*l.* to 10*l.*, some few much higher; but where farmers want rams only for cross-bred lambs, nicety of blood or perfection of make is not so requisite as when they rear pure-bred animals. The majority, therefore, do not feel inclined to give more than 10*l.* for the very

best sheep, which, under favourable circumstances, will be 2*s*. 6*d*. a head for each lamb they rear.

A better style of pig is now seen in this county. They are thicker and more disposed to fatten, and at the same time large and hardy enough for the straw-yard. A good many Berkshires have lately found their way to West Norfolk; but as all pork is scalded, there is a prejudice among some of the butchers against black or spotted pigs. Not so many pigs are kept in the fat-bullock yard as formerly. When the flail was used the corn was not thrashed so clean as it is by machinery, and there was sure to be some feed near the barn-door. Now that there are not so many stray kernels for them to find, a great many restless pigs rooting about a yard are sure to disturb the periodical dozes of the quiet sleepy oxen.

From what has been said about the live stock, it will be readily imagined that Norfolk takes a more conspicuous place at the shows of the Smithfield Club than at those of the Royal Agricultural Society. Whoever has visited Baker-street, or Bingley Hall, will find that the county which produces the greatest amount of beef is not behindhand in furnishing choice specimens of the best fattened oxen in the world. Some of the much coveted prize-cards at these shows are sure to contain the words "Ludham," or "Holkham;" and more premiums for cross-bred sheep have come into Norfolk than to any other county; it has also had more than its proportion for South Downs. In this class Norfolk takes a very high standing at the exhibitions of the Royal Agricultural Society; and our county may be well proud of the splendid animals which are annually exhibited from the flocks of Weasenham and Merton. At Salisbury, Norfolk was well represented; while at Chelmsford, five out of the six South Down prizes came into our county.

The Norfolk cart-horses are hardy and useful animals, without being at all perfect in shape, or uniform in breed. It is the custom to say, that the horse stock in this county is the worst feature in its agriculture. It may be so, but there are few districts where cart-horses do more hard work. Sir John Walsham's statistics show that about four horses are kept on each 100 acres of arable land, but this includes all the colts on the farm, and, in fact, every head of horse stock which the farmer keeps. It is usual to make a comparison between the number of horses kept in the north and south of the kingdom; but the justice of this comparison depends on the nature of the soil, the quantity of permanent pasture, and the proportion of the arable land which is devoted to roots and grain. Considering the large portion of land in Norfolk devoted to the growth of corn and

turnips, a great many horses must always be kept. Cart-horses have latterly received more corn and less hay. It was usual to rack up horses in the stables and yards with long hay, but a very small portion is now given long, almost all being cut into chaff. The average allowance of corn for a cart-horse is from one to two bushels per week, one-third being beans when the work is hard. The refuse barley is frequently sprouted and given to horses; and in the east, where there are many large corn-mills, a great deal of pollard or bran is also consumed by them. Horses in the summer are kept as much as possible in the yards, and are then fed with rye, vetches, clover, sainfoin, or any long grass that can be had.

Working oxen do not increase. Devons are mostly used as workers: they are active, and stand the heat better than any other cattle. On off-lying premises, where no labourers reside, a team of bullocks frequently answers well. Horses want grooming, and long attendance to feed them properly; but the working cattle, if at once supplied with their provender, can be turned into a yard, and require no further attention.

With the vast amount of valuable live stock in Norfolk, it is really wonderful that there are so few properly qualified veterinary surgeons. Some there are in the towns, and a few in the country, able and excellent practitioners, but the great mass of the cattle-doctors are but a shade better than the original cow-leeches of olden time. The blunders these men make are endless, and the consequences of such errors necessarily fall on their employers. Considering the experience which some of these farriers have, it is curious that practice has not taught them some of the first rudiments of veterinary science. Farmers themselves frequently know but little of the diseases of cattle, and many of the cow-doctors know even less. There are many parts of the county where there is a good opening for a hard-working veterinary surgeon, but there are natural hindrances to a successful start. Such a man must be well paid, and the parish blacksmith can of course work cheaper than he can. Farmers are too apt to forget that quality is the true test of cheapness; they grumble at paying respectable veterinary surgeons' fees, but do not mind the farrier's small account, which is often dovetailed in with the blacksmith's bill. So long as this penny-wise and pound-foolish plan is carried out, the qualified practitioner has up-hill work; but when the knowledge of his profession is better understood, his services cannot fail to be more appreciated. A science which mitigates the sufferings of some of the noblest and most useful animals in creation, and by saving a vast amount of human food increases the wealth of the country, can never be an unworthy study. How singular it is, when other professions are over-

crowded, that this one should be left almost entirely in the hands of unqualified and ignorant persons!

Within the last fifteen years, but more particularly during the last five, the rents on some of the large light land estates of West Norfolk have increased. The average advance of rent on such soils has been computed at from 10*l.* to 15*l.* per cent. In the East rents have also risen, perhaps, from 5*l.* to 10*l.* per cent; but there is this difference, that in West Norfolk the lands, from being farmed well for 14 or 21 years, are, at the expiration of such leases, really better farms and worth more to a tenant: in the East the land is no better than it was, but farmers increase while farms do not, and so, as the demand exceeds the supply, prices rise. Corn-rents are not common in Norfolk, but under all the new leases on the Holkham estate the rent is paid as follows: one-third in money, one-third in wheat, and one-third in barley: of course the money never varies, but the wheat rises from 18*s.* to 28*s.* per coomb of 4 bushels, and the barley from 12*s.* to 16*s.* The fixed rent supposes the price of wheat to be 5*s.* and barley 3*s.* per bushel. Perhaps the working of this corn-rent would be better understood by the following illustrations. Let the amount of rent be fixed at 900*l.*, it would vary thus:—

Starting Point.		Lowest.		Highest Rent.	
	£.		£.		£.
One-third Money..	300	One-third Money..	300	One-third Money..	300
One-third Wheat, 1200 bush. at 5/	300	One-third Wheat, 1200 bush. at 4/6	270	One-third Wheat, 1200 bush. at 8/	480
One-third Barley, 2000 bush. at 3/	300	One-third Barley, 2000 bush. at 3/	300	One-third Barley, 1200 bush. at 4/	400
	900		870		1180

The price of corn is taken from the average of the last three years. It will be observed that these rents rise a good deal, but fall very little; they are fixed at the lowest point at which it is considered corn can range, but it would simplify the matter to start from the *very lowest point* and so have no drop at all, and to take the average price of the last year instead of the last three; of course it all depends on how the start is effected, and it must be said that on the Holkham estate the start is made fairly and liberally.

In all the parishes in which the tithes were not fixed in 1843 a commutation has since taken place. The New Poor Law, which had then only begun its operations, has since become better understood, is better worked, and better appreciated. The labourer is certainly not so badly off as he was 15 years ago.

The amount of wages still depends on the price of wheat; but the run of wages is higher than formerly. Wheat at the present time averages two guineas a quarter, and day labour is 9*s.* a week in the east and 10*s.* in the west of the county; formerly the rate would have been a shilling under those prices. The third of a coomb of wheat was the old standard for a week's labour, or some calculated it at a bushel of wheat and 3*s.* Either of these rates would be less than is at present paid, and therefore it may be fairly argued that the daily pay of the labourer has increased. The difference between the rates of wages in the east and west has always existed. They are rather shorter of labourers in some districts of the west, and from the absence of competition among millers flour is always 2*d.* and sometimes 4*d.* per stone dearer in West Norfolk than at Norwich. Certainly taskwork costs more than it did; whether it be mowing, hoeing, draining, hedging, or what not, nothing is done at the old prices. All farmers on comparing their present expenditure of labour with that of any season 15 or 20 years back, when corn was at a similar price, concur in stating the increase at fully 20 per cent. This does not entirely arise from the labourer being better paid; it is also a fact that more manual labour is employed than formerly, notwithstanding all the aid which machinery affords. It is not the decrease of population which has made labourers scarce in parts of West Norfolk, but it is the improved mode of farming which absorbs more manual labour. Several parishes could be named which in the days of the old Poor Law had all winter long from ten to twenty ablebodied men on the roads, and which, notwithstanding the increase of population and cottages, have now to import labourers from adjoining villages. Hitherto there has been no general or real scarcity of labourers; but with an extending emigration, and the drain on the rural population for the army, there is not likely again to be an overplus.

The moral and social condition of the labourer has recently attracted much attention; and within these fifteen years the upper and middle classes have exerted themselves to improve his home and educate his children. But however much may have been done to elevate the condition of the poor man, much, very much, remains unaccomplished. In many parishes there is no school, no resident squire or parson—in fact, no purse or hand to minister to the wants of the poor. The worst cases are some of the overgrown open villages of West Norfolk. Here people build cottages for gain, and demand exorbitant rents. The scum of the neighbourhood settles down in this spot; for should a man lose his honesty, or a woman her virtue, both are ejected from the close parish, and of course take up their abode in the next open one. The houses are small and dear, crammed with grown-up children

and lodgers. The sanitary state of the village is as bad as possible; for it is a common opinion that a country parish *must* be healthy, and *can* want no system of drainage. The parson, if he be resident, is generally a poor vicar, receiving a stipend at which an engine-driver would turn up his nose. To have to live like a gentleman without the means must ever remain an intricate problem to solve; and the charge of so refuse a flock must be indeed a heavy burden. Unfortunately it too often happens with men so situated that, as they can do so little good in such a parish, they therefore do none. The farmers are kind enough to their own folk, yet naturally care but little for the riffraff of other parishes; while the charities of the landed proprietors are frequently withheld from lack of a proper medium through which to distribute them. Ills like these, without any sound remedies being applied, will produce their sad effects. Some of these overgrown villages are indeed little colonies of vice, populated by an ignorant, degraded, and idle set of beings.

Norfolk always has been, and always will be, a great game county. It is slack in hunting amusements; and although the Norfolk hounds have recently been re-established, pheasants will always be more zealously preserved than foxes. It is the natural soil for game, and affords a great amount of sport to the proprietors. Tenants never object to winged game, but no man can farm against an overplus of hares and rabbits. Happily the amount of foot-game is very much less than in the days of the last Report. Then it was no uncommon sight to see whole fields of corn destroyed by hares and rabbits. The injustice of letting land at its full value, and then stocking it with such game, was so manifest that all reasonable landlords now keep the foot-game within moderate limits. Yet there are still a few unfortunate and exceptional estates, on which the game does an immense amount of damage. On one small property in the south-west of the county the rabbits were let last autumn during three months for 800*l.*!

There is one progression which cannot be regarded as an improvement, and that is the increased value recently put upon a tenant's covenants. Covenants in Norfolk are understood to be the hay, roots, &c., that one tenant leaves on a farm at Michaelmas, and which his successor takes at a valuation. There is no fault to find with the principle of these valuations; it is the simplest and best which is employed in any county. The roots, as well as the hay, are valued at what they are worth, not at what they have cost for ploughings, manurings, and the like. The incoming tenant pays for the thrashing of the corn crop, and delivers it, taking the "straw, chaff, and cavings" (in Norfolk

"colder") in return; but the covenant prices of hay and roots have become so high, that for these and the clover seeds the incoming tenant on good land has to pay as much as 50*s*. per acre on his entire farm, and the occupier of lighter lands in smaller proportions. A great deal of hay has been valued within the last three years at 4*l*. and 4*l*. 4*s*. per ton, and swedes at 6*l*. per acre. The only portion of the Norfolk covenants which is really worth the price paid for it is a good crop of mangold wurtzel. This may weigh 30 tons per acre, and would be valued at 7*l*.; but before this crop is used there is a serious outlay on it. It has to be pulled, topped, loaded, carted, stacked, thatched, banked, uncovered, trimmed, and carted again, before the roots are ready for the stock.

It would be a great improvement if the tenancies of farms commenced at *New* instead of *Old* Michaelmas. A fortnight at that season is invaluable to the new tenant, and the old one has literally nothing to do. On entering a farm on the 11th of October there are some stubbles to clean for rye and vetches, the muck to cart, the ley ground to plough and sow with wheat, perhaps some corn to deliver, and certainly there are the mangolds to store. All this has to be done in six weeks, not unfrequently the wettest season of the year. The loss of that fortnight between New and Old Michaelmas throws an incoming tenant back a whole year. His autumn tillage cannot be done, his wheats are late and often a poor thin plant, and some of his mangolds are still abroad when the first frost sets in. On entering a Norfolk farm, this Old Michaelmas day is a great evil; yet, like many other grievances, it is upheld, not from any compensating benefit it possesses, but simply from the difficulties and inconveniences which must ever attend the first deviation from an old and almost universal custom.

Notwithstanding all the increased facilities for growing roots which artificial manures afford, the turnip crop throughout Norfolk does not greatly increase in quantity, and certainly is worse in quality. Whether it is from over stimulation or from too frequent repetition, the swedes sown are attacked with all sorts of new diseases, and show a greater tendency to decay. White turnips, from not bearing to be forced or sown early, are less grown than formerly; but if they are planted in reasonable time they produce more early feed at less expense than swedes, and are often sound and good till the middle of December: but mangold wurtzel is decidedly the favourite root now. It is easier to grow 30 tons of mangolds per acre than 20 of swedes, and they do not mind the drought of summer. Last season the swedes in Norfolk were the worst that have been known for years: they

had hardly any bulb, but plenty of roots, neck, and top. The mangolds were excellent, and a much larger breadth than ever have been sown in 1858. Some little idea may be formed of the annual increase of this root by referring to the statistics of 1853 and 1854. In the former year the breadth grown in Norfolk was 13,618 acres; in the next season 16,274, which is an increase in a single year of one-fifth. Since then the cultivation of mangold wurtzel has extended itself in a still greater degree, and in many parts of the county ten acres are grown where there was not more than one fifteen years ago.

When box-feeding came up the culture of flax was also brought into notice; the extent grown does not increase, and the linseed compound for cattle, which was to form part of the box system, was speedily given up. Of the other little crops which are occasionally grown, perhaps cabbages are more general than formerly; they are cultivated chiefly for ewes and lambs in the spring, and for this purpose the thousand-headed variety is the favourite.

Many of the existing farm-buildings have been much improved, and several new homesteads erected during the last fifteen years. Covered yards are not numerous in this county: there are some capital ones at Thetford Abbey, at Wretham Hall, and on the Hillborough estate. A spacious and most complete set of farm-buildings has been recently built at Egmere; then there is the compact steading at Cranmer, and the very useful new farm-premises at Barton Brudish, all of them capital specimens of improved agricultural buildings. All over the county there are excellent new premises to be seen, and the general aspect of the old ones is decidedly better than it was fifteen years ago. Besides the few covered yards, there are for cattle-feeding stalls, loose boxes, and open yards. Sheds for tying up cattle were common in this county during the last century, but box-feeding is of recent date; yards, with open sheds, are still the most general for fattening cattle in Norfolk. After trying all the other methods, farmers appear to be well content with yards: not the large enclosures which are called farmyards in some counties, but small yards for 10 or 12 beasts, on two sides of which are warm and wide open sheds. Certainly, cattle thrive amazingly well in such small yards; but, even in a little community of a dozen, a few will be tyrants, so the rest must be slaves. As the sheds are all spouted round, no great amount of water falls into the yard, and no liquid manure escapes. Where straw is scarce, or can be advantageously sold, an argument is furnished against open yards; but on large arable farms, cattle being regarded as expensive machines for manu-

facturing good manure, the presence of a little rain-water in the yard is considered no detriment; it enables the cattle to tread down more straw in less time, and, although the manure is not so concentrated as that from loose boxes, it is made at less expense. On the other hand, where landlords provide boxes, tenants are only too glad to avail themselves of the change. There can be no doubt that cattle do best in them and make the richest manure, but the first outlay entails a heavy expense on the proprietor. In boxes, cattle eat less than in yards; they are always dry and warm, they can move about when they like, and lie in any position they please; and if the litter be well managed—that from the corners being moved into the middle and the straw kept level—no escape of gas can be detected by the most sensitive olfactory nerve.

Norfolk owes much of its good farming to the judicious application of its substrata to the surface-soil. In olden times it was considered essential to clay, marl, or chalk lands at certain intervals; but these dressings are much less needed now,* as cheaper substitutes are found for many of the most valuable fertilising properties of these mineral manures. Thus salt is supposed to stiffen the straw as well as chalk, and there can be no doubt that superphosphate produces some of those results which constituted the chief value of a dressing of marl. Of course, where lands require to be consolidated, such as peat and light sands, nothing can be applied which will be of so much service as a good coat of heavy clay; this acts mechanically and solidifies the soil, but, if only chemical result is wanted, that result is often obtained in a quicker and cheaper form from some artificial fertiliser. Hence claying and marling friable loams is not so general as formerly, and the indiscriminate application of mineral manures to all soils is quite going out of fashion.

Fifteen years ago there was no railway communication between Norfolk and London. Cattle and sheep for the Smithfield Monday market had to leave their homes on the previous Wednesday or Thursday week. Such a long drift, particularly in hot weather, caused a great waste of meat. The heavy stall-fed cattle of East Norfolk suffered severely. The average loss on such bullocks was considered to be 4 stones of 14 lbs., while the best yearling sheep are proved to have lost 6 lbs. of mutton and 4 of tallow; but beasts from the open yards and old sheep, with careful drovers,

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* Probably one of the principal reasons for claying or marling not being so much needed as formerly, is the improvement produced in the composition and staple of the soil by the successive dressings already applied.—H. S. T.

did not waste in like manner. Stock now leave on the Saturday and are in the salesmen's layers that evening, fresh for the metropolitan market on Monday morning. The cost of the rail is considerably more than the old droving charges; but against that there is the gain of 20*s.* a-head on every bullock a Norfolk farmer sends to town, to say nothing of being able to take immediate advantage of a dear market.

The last number of the 'Quarterly Review' contained a very clever article on the progress of English agriculture. It is gratifying to the farmers of this county to find that the improved cultivation of England and of Norfolk are treated as synonymous terms, for the greater part of this paper in the 'Quarterly' refers more to improvements in Norfolk agriculture than to the progress of farming generally throughout the kingdom. From the middle of the last century Norfolk has stood foremost in everything which tends to elevate this important branch of our national wealth; and though its honourable position is not so conspicuous now, the very able writer in the 'Quarterly' remarks, that, "if Norfolk no longer occupies its leading position, it is not because it has dropped behind in the race, but because other counties have pushed forward, and the course of events are tending to equalize the arts of cultivation throughout the kingdom." This is, doubtless, very true; the farming of other counties has wonderfully progressed, and it is always easier to make a start than to keep the lead; but it would puzzle any one to find another district, with a *naturally barren* soil like West Norfolk, that annually produces such large supplies of corn, meat, and wool for our increasing population. Other parts of the country may be quite as well farmed, and there may be districts where occupiers save more money, but *none in which such an amount of the necessaries of life is raised by artificial means.* At any rate, Norfolk farmers cannot be taxed with having stood still. On the contrary, they have exerted themselves to the utmost to produce "victuals, drink, and clothing" for this great nation. In the latter part of the low times, which ranged from 1847 to 1853, the production of corn in Norfolk sensibly diminished, whereas the better price of the last few years has again caused an increased growth. After a succession of unremunerating years, not only do very inferior soils go out of cultivation, that is, are kept as sheepwalks or grass, but less corn, less meat, and less roots are produced on good lands—for artificial manure and artificial food do not always rise and fall with the price of corn. The sudden start in the value of wheat in 1853 must be fresh in the memory of every one engaged in agriculture. The effect of this rise on the farming of Norfolk was a subject of general remark, and it so

happened that in 1853 and 1854 the agricultural statistics of this county were collected; and the value of such tables is shown by their furnishing such facts as these, *that in* 1854 *there were* 13,089 *acres more wheat than in the preceding year*, 7594 *acres less of bare fallow, and nearly* 10,000 *more bullocks kept in the county!* Farmers delight in the idea of producing large supplies of grain and meat for the increasing multitude; but their business-object in manufacturing these necessaries is not to feed the public, but to make farming pay. At reasonable rates this high farming will answer; with very low prices it cannot. The same laws which govern the manufacturing world operate not less *surely*, though more *slowly*, on the farming interest. If the production of any article answers, that article will be produced. If it does not pay the cost of production, the manufacture of it declines, and not till remunerative prices return will the supply of it increase. Among the many leading agriculturists of the county who have been consulted, not one of them but says that farming requires more capital than ever; but the profits on the money invested are much smaller than formerly. Farmers' expenses increase, and though, of course, their receipts are also more, they have not yet increased in the same proportion. There can be very little doubt of the truth of this conclusion. Improved farming means, in other words, the judicious application of more capital to the cultivation of the soil; and as the broad acres of Old England cannot be made broader, it is the business of every British yeoman to make them more productive; but he wants, like other producers, to live by his occupation, and expects to be paid for his time and his capital. If the nation require the farmer to produce more of the necessaries of life, every obstacle which now hinders improved agriculture should be removed, and every facility afforded for the security of that capital which the tenantry must now, more than ever, embark in the cultivation of their farms.

Statistics and figures are dry things, but are nevertheless very useful. Mention has been made of the Norfolk statistics which Sir John Walsham so ably collected in 1853 and 1854. From these some idea may be gathered of the productive power of this county, and they form a reliable source of information as to the state of the crops and the number of stock then kept. Comparisons, if they are not always odious, are seldom pleasing, and so but one will be attempted. It is simply this: that in 1854 there were 267,000 more acres of wheat and barley grown in Norfolk and Suffolk than in the whole of Scotland; and the county of Norfolk alone produced 1,290,373 more bushels of wheat than all the land north of the Tweed.

Norfolk Agricultural Statistics, 1854.

Total number of Acres in the County 1,281,278

Number of Acres under Tillage.	Acres.
Wheat	202,971
Barley	173,831
Oats	35,203
Rye	5,807
Beans and Peas	20,767
Vetches	3,252
Turnips	161,186
Mangold	16,274
Carrots	757
Potatoes	1,958
Flax	217
Other crops, such as Cabbages, &c.	8,074
Bare Fallow	10,202
Clover, Lucern, and other artificial Grasses	171,891
Permanent Pasture	192,745
Total	1,005,135

Live Stock.	Number.
Horses	56,350
Cattle	99,928
Sheep	841,591
Pigs	99,773

Sir John Walsham, being "supplied with a very considerable number of estimates of produce, upon which he was justified in placing full reliance, from every part of Norfolk," published the following as the average produce of cereals per acre and the produce of the whole county :—

	Produce per Acre. Bush.	Pks.	Produce of the County.
Wheat	30	1	6,139,872 bushels.
Barley	38	2	6,692,493 ,,
Oats	46	0	1,619,236 ,,

These are creditable averages for a county the greater part of which has a naturally barren soil. A yield of 30 bushels per acre over an extent of more than 200,000 acres—including thin chalks, hungry gravels, and blowing sands—is a respectable crop, and shows what good farming has done for this county. There is but a small portion of Norfolk that can be considered the natural soil for wheat; and it is therefore the more creditable that the farmers have produced such an increase of the staff of life. It is different with barley, for in favourable seasons it readily grows large crops of that grain, of superior quality. Oats do not appear to suit the soil or climate very well; the yield is insig-

nificant when compared with that of other counties, whose averages of wheat and barley fall far below those of Norfolk. But oats, when they form part of a rotation, are only grown on the poorest soils; when sown on better land they generally follow wheat, and of course do not yield so largely as if they grew after turnips or were planted on ley-ground.

Although there were several Tables of the actual yield of various farms in the last Norfolk Report, it does not appear that any general estimate of the average produce of the whole county was attempted. The great increase of grain grown in the vicinity of Norwich will be shown by comparing the corn returns of different periods.

In 1805 the quantity of wheat sold in Norwich market amounted to only 25,422 quarters. In 1843 the returns were as follows:—

	Wheat. Qrs.	Barley. Qrs.	Oats. Qrs.	Rye. Qrs.	Beans. Qrs.	Peas. Qrs.
	124,872	134,099	633	250	1,185	525
In 1857—	168,739	181,400	1,226	497	853	223

This shows a wonderful increase in the quantity of both wheat and barley sold at Norwich, but a portion of the excess may be attributable to the more stringent manner in which the returns are enforced, and greater care being taken in the preparation of these Tables. Another reason may be assigned for this advance: Norwich market has become better attended since the formation of the railroads, but other local markets have also improved, and, now that iron and glass are so cheap, corn-halls are being built in every good-sized town of the county.

Mr. Bacon furnished some very interesting tables of the exports and imports at Lynn, Yarmouth, and other sea-coast towns, showing the quantity of grain sent out of the county, and the large amount of oilcake and artificial manure brought into it. Such statistics would now be of no service, and might probably produce wrong impressions, as so much merchandise now ebbs and flows into Norfolk by the railroads. Enough has been stated to show that there is a largely increased growth of most grain, but especially of wheat; and now that there is so little difference between the price of that cereal and of barley, it is probable that the extended cultivation of wheat will be checked, and a larger quantity of barley grown.

It is quite impossible to make anything like an accurate guess at the number of store cattle which, from all parts of England, Ireland, and Scotland, are annually sent into Norfolk to be grazed. The outside number in 1815 was put down at 15,000; but Sir John Walsham's returns state the head of cattle in

Norfolk, in 1854, at nearly 60,000. Besides these, there were 40,000 cows and calves; but that number included working oxen and young stock. Certainly not above one bullock in twenty that is grazed in Norfolk is bred in the county. These returns were furnished directly after harvest, at which time the Norfolk farmers had not bought their *winter stock, which greatly outnumbers the quantity kept in the autumn;* and cattle are seldom held more than twelve, and generally less than six months. It is therefore a moderate calculation to suppose that 50,000 of those cattle are disposed of annually; and as the oxen are always bought in a lean state and sold out fat, the amount of beef which Norfolk produces must be immense. The quantity of sheep kept in Norfolk is not so great as in some other counties; though the number wintered every year has been computed to be not less than eight or nine hundred thousand.

Norwich cattle-market is a weekly fair; it annually increases in magnitude, to the extinction of almost all the local fairs in the county. Any attempt to obtain information as to the extent and increase of this wonderful mart has failed, as there is no charge for cattle, and consequently no account taken of their number. At Lynn (the second largest market in the county) the tolls are collected by the corporation; the number of cattle, sheep, &c., exhibited in that town in 1836, 1843, and 1857, shows a rapid increase:—

Years.	Sheep.	Pigs.	Bullocks.	Horses.
1836	22,180	22,121	10,435	194
1843	53,665	25,172	16,363	284
1857	115,277	21,252	21,591	693

There is a considerable increase in the supply of everything save pigs, which confirms the remark that has been made about fewer store-pigs being kept than formerly.

The amount of poor-rates in Norfolk has been much reduced since the introduction of the new law. Mr. Bacon gives the amount of poor and county-rates in 1833 at 358,006*l.*; last year they were 252,909*l.*, the average of the past seven years being 227,582*l.* The county levies in 1842 were only 16,200*l.*; in 1857 they were 27,247*l.* Of this sum the large portion of 15,240*l.* was raised for the rural police—which is almost as much as the whole rate levied in 1842, the police force having been established two years previous to that date. The assessment of the county to the old property-tax was 1,439,977*l.*; in 1843 the sum was 1,945,558*l.*, and last year it amounted to 2,104,198*l.*

Sir John Walsham, in 1853, made a valuation of the live and dead farming-stock in the union of Aylsham. South Erpingham hundred does not lay claim to be the best-farmed district in

Norfolk; nor are its live stock and implements considered to be pre-eminently good; in no particular does it do more than represent a good average of the county. Aylsham Union contains 47,665 acres, and the value put on the live and dead farming-stock, "at a moderate rate," was 2,400,000*l*. There are certain parts of the county where the land is not so good, and the stock not so numerous; but after making a deduction for these barren parts, the value of the live and dead farming-stock in Norfolk cannot, on this calculation, be less than 40,000,000*l*. This is exclusive of all the floating capital engaged in carrying on the farms from one year to another, and of that vast amount of tenants' property, which is invested in the permanent improvement of the land.

It is melancholy, in looking through the list of those who contributed the practical materials of Mr. Bacon's Report, to see what ravages death makes in fifteen years even in the ranks of the stalwart farmer. Of those eighty men, the best agriculturists Norfolk could produce, nearly one-fourth now mingle with the dust they so long and so ably cultivated. There can be little doubt that Norfolk farmers, as well as Norfolk farming, have progressed within the last fifteen years. The superior character they then bore they still continue to sustain; and as a description of them comes with more force from one who is not connected with agriculture, the following eloquent remarks with which Mr. Bacon concluded his Report are here added. He had been reviewing the general advancement of the agriculture of the county, and thus sums up his ideas of the farmers: "The effect of this advance upon the tenantry themselves is what might justly be expected from the employment of greater capital and enlarged minds and information. They are generous, independent, hospitable, free, intelligent, and very many have carried intellectual pursuits and acquirements far beyond the race of farmers of former times. They are wisely anxious to avail themselves of those opportunities which the increasing intelligence demands of every man the important business of whose life it is to provide for the wants of a powerful, intellectual, and extended empire."

In writing a Report of this kind it is difficult to know where to begin and when to finish. A regular essay on the agriculture of a county should thoroughly explain every branch of its farming; but in these few remarks on the improvements in Norfolk agriculture within the last fifteen years nothing of the kind has been attempted, and they have been strung together just as the facts, one by one, happened to be noticed. Without claiming the rare merit of strict accuracy, it is only right to state that all these remarks are founded on evidence collected

with great care from every part of the county; and though names have been studiously avoided, each fact recorded can be truthfully substantiated. Some Norfolk farmer, in overlooking these pages, may say, "That is not how I farm, nor is it the practice of my neighbourhood." Probably not; but if every peculiarity of each district had been noticed, these remarks would have extended to a most unreadable length. Enough, it is hoped, has been described to give a brief outline of recent progress in Norfolk agriculture. To those gentlemen who obligingly furnished the materials of this Report the writer offers his warmest thanks, not only for the information which they so readily afforded, but also for the courtesy with which it was rendered, and for their free and generous hospitality.

Plumstead, Norwich, 1858.

APPENDIX.

The following experiments on top-dressing wheat with different doses of nitrate of soda and salt, which were made on the Holkham Park Farm in the years 1850–1857, are interesting and instructive. For variety and extent, and for the care and ability with which they were conducted, these experiments have seldom been equalled. They show the capricious influence of our climate on the wheat crop, and illustrate very forcibly the folly of supposing that any new agricultural fact is proved by one set of experiments. Notwithstanding the varied result of these dressings, all are satisfactory, for there is hardly one of moderate cost that has not answered. The results of these trials must nevertheless be received with some degree of caution, and nitrate of soda must not be expected to produce an equal effect on all lands. The soil of Holkham Park is particularly adapted for this system of high farming. The surface soil is a light sandy loam, which requires much stimulant, and the subsoil is a chalk sufficiently dry, cool, and grateful to prevent the forced straw from lodging. Some soils do not want such assistance, and other barren lands lie on such poor and weak substrata that they cannot bear any extra forcing. The experiments show that Holkham is not the *natural soil for wheat.* In those wet seasons when there was so poor a wheat crop throughout the kingdom, the nitrate of soda produced the greatest results. Last year was too hot and dry for West Norfolk; and although the general crop of wheat in England was abundant, at Holkham it was poor, and the soda did the least good. The practical result of these experiments is, that on the Holkham Park Farm from 6 to 8 stone (1 cwt.) of nitrate of soda, mixed with double the quantity of salt, is applied to all the wheats; the quantity used being varied according to the strength of the plant, or condition of the land. The soda and salt are best applied in two dressings: the first half when the wheat takes its early start in February or March, the rest some time in April,

when the wheat is growing vigorously. The experiments of the first two years have already appeared in the Society's Journal in an excellent letter addressed by Mr. Keary to the late lamented Mr. Pusey, but it will not take up much room to insert them again; and as it will complete the whole set, no apology is considered necessary for again presenting them to the notice of the members of the Society.

RESULTS of EXPERIMENTS on TOP-DRESSING WHEAT with Nitrate of Soda and Salt, made upon Holkham Park Farm, in the years 1850 to 1857.

Year.	No. of Exp.	Nitrate of Soda.	Salt.	Cost of the Top-dressing.	Yield of Corn per Acre.	Increase in Corn over Exp. No. 2.	Weight of Straw grown per Acre.	Increase in Straw over Exp. No. 2.
		Stones.	Stones.	£. s. d.	Bus. pks.	Bus. pks.	Tns. cwt. st.	Tns. cwt. st.
1850	1	6	16	0 14 6	45 2	4 2	1 12 2	0 6 2
	2	Nil.	Nil.	..	37 0	..	1 6 0	..
	3	8	16	0 13 6	40 0	3 0	1 14 0	0 8 0
	4	4	8	0 9 3	39 0	2 0	1 10 4	0 4 4
	5	10	20	1 3 3	40 0	3 0	1 12 4	0 6 4
	6	8	Nil.	0 16 0	40 0	3 0	1 12 0	0 6 0

1851	1	6	16	0 14 6	42 2	4 3	1 13 1	0 5 6
	2	Nil.	Nil.	..	37 2	..	1 7 2	..
	3	8	16	0 18 6	45 1	7 2	1 16 5	0 9 2
	4	4	8	0 9 3	43 1	5 2	1 13 4	0 6 2
	5	10	20	1 3 3	47 0	9 1	1 18 4	0 11 2
	6	8	Nil.	0 16 0	43 3	6 0	1 17 1	0 9 7

MEM.—Seven loads of farmyard manure per acre applied over the whole field before ploughing the clover-ley.

1852	1	6	16	0 14 0	39 $3\frac{13}{16}$	20 $3\frac{13}{16}$	1 14 $2\frac{3}{14}$	0 17 $2\frac{3}{14}$
	2	Nil.	Nil.	..	19 0	..	0 17 0	..
	3	8	16	0 17 9	37 $3\frac{12}{16}$	18 $3\frac{12}{16}$	1 14 $2\frac{3}{14}$	0 17 $2\frac{3}{14}$
	4	4	8	0 8 $10\frac{1}{2}$	32 $1\frac{5}{16}$	13 $1\frac{5}{16}$	1 7 $1\frac{1}{14}$	0 10 $1\frac{1}{14}$
	5	10	20	1 2 $3\frac{1}{2}$	42 $1\frac{14}{16}$	23 $1\frac{14}{16}$	1 15 $5\frac{11}{14}$	0 18 $5\frac{11}{14}$
	6	8	Nil.	0 15 3	42 $2\frac{14}{16}$	23 $2\frac{14}{16}$	1 16 2	0 19 2

MEM.—Six loads of farmyard manure per acre applied before ploughing the layer.

				£. s. d.	Bus. pks.	Bus. pks.	Cwt. st. lbs.	Cwt. st. lbs.
1853	1	6	12	0 15 2	39 0	14 3	30 4 8	7 5 10
	2	Nil.	Nil.	..	24 1	..	22 6 12	..
	3	8	16	1 0 3	33 3	9 2	30 0 0	7 1 2
	4	4	8	0 10 $1\frac{1}{2}$	32 2	8 1	27 3 6	4 4 8
	5	10	20	1 5 4	36 0	11 3	29 1 2	6 2 4
	6	8	Nil.	0 18 0	35 0	10 3	32 2 4	9 3 6

MEM.—Six loads of farmyard manure per acre applied in July, 1852.

Top-dressing Wheat with Nitrate of Soda and Salt—*continued.*

Year.	No. of Exp.	Nitrate of Soda.	Salt.	Cost of Top-dressing.	Yield of Corn per Acre.	Increase of Corn over Exp. No. 2.	Weight per Bushel.	Increase of Straw over Exp. No. 2.	Weight of Straw per Acre.
		Stones.	St.	£. s. d.	Bus. pks.	Bus. pks.	St. lbs.	Cwt. st. lbs.	Cwt. st. lbs.
1854	1	6	12	0 16 0	46 0	6 0	17 10	4 2 4	45 5 10
	2	Nil.	Nil.	..	40 0	..	18 4	..	41 3 6
	3	8	16	1 1 6	47 0	7 0	18 0	3 3 6	44 6 12
	4	4	8	0 10 9	46 0	6 0	18 2	..	40 0 0
	5	10	20	1 7 0	48 0	8 0	17 12	1 5 10	43 1 2
	6	12	24	1 12 0	52 1	12 1	17 11	5 2 10	46 6 2
	7	8	Nil.	0 18 6	49 2	9 2	17 9	8 4 8	50 0 0

Mem.—Six loads of farmyard manure per acre applied in July, 1853.

Year.	No. of Exp.	Nitrate of Soda.	Salt.	Cost of Top-dressing.	Yield per Acre. Head Corn.	Yield per Acre. Tail Corn.	Total Yield.	Excess over No. 2.	Weight per Bushel.	Straw per Acre.
		Stones.	Stones	£. s. d.	Bus. pks.	Bus. pks.	Bus. pks.	Bus. pks.	lbs.	Cwt. lbs.
1855	1	6	12	0 15 9	39 3	1 0	40 3	5 3	61	30 21
	2	Nil.	Nil.	..	34 1	0 3	35 0	..	61	27 6
	3	4	8	0 10 6	38 0	0 3	38 3	3 3	61	29 19
	4	8	16	1 1 0	41 1	1 0	42 1	7 1	61	32 80
	5	10	20	1 6 3	42 2	1 0	43 2	8 2	61¼	34 11
	6	12	24	1 11 6	41 2	1 1	42 3	7 3	61	35 28
	7	saltpetre 8	Nil.	0 18 0	42 0	0 3	42 3	7 3	62	32 16
	8	8	16	1 3 0	41 3	1 0	42 3	7 3	63	31 4
	9	cwt. 3	..	1 1 0	35 2	1 0	36 2	1 2	62¼	26 0
	10	„ 3	..	1 4 0	34 1	0 3	35 0	..	62¼	26 40
1856	1	6	12	0 16 0	47 3	1 2	49 1	4 3	63	46 14
	2	nil	nil	..	42 2	2 0	44 2	..	62	36 68
	3	8	16	1 1 6	49 3	2 0	51 3	7 1	63	45 79
	4	10	20	1 7 0	50 2	2 0	52 2	8 0	62	43 98
	5	4	8	0 10 9	48 1	2 2	50 3	6 1	62½	45 86
	6	12	24	1 12 3	47 0	2 2	49 2	5 0	62½	40 24
	7	8	nil	0 18 6	48 1	2 2	50 3	6 1	62½	41 48
	8	saltpetre 8	16	1 3 0	49 2	1 2	51 0	7 0	62½	40 28

Mem.—Sown in two dressings in April.

1857	1	6	6	0 14 6	31 0	1 0	32 0	4 2	61½	18 44
	2	nil	nil	..	26 2	1 0	27 2	..	60¼	17 28
	3	8	8	0 19 4	34 0	1 0	35 0	7 2	61	20 110
	4	10	10	1 4 2	35 2	1 0	36 2	9 0	60¼	22 60
	5	4	4	0 9 8	28 0	0 2	28 2	1 0	60¼	17 22
	6	12	12	1 9 0	30 0	1 0	31 0	3 2	61	17 96
	*7	8	..	0 18 0	25 0	1 0	26 0	..	61	15 46
	8	saltpetre 8	8	1 4 0	21 3	0 3	22 2	..	61	13 20
	9	..	36	0 6 6	23 2	1 0	24 2	..	61	13 38

* This is the only experiment, out of more than 50, in which nitrate of soda has not produced an increase, and usually a paying increase, of wheat; it will be observed that there was no salt used in this instance. The saltpetre diminished the yield 5 bushels per acre, and the salt, when applied alone, at the rate of 3¼ cwt. per acre, also knocked off 3 bushels. The singular results of these three closing experiments appear very unaccountable, being quite at variance with all the preceding.

The experiments at Holkham Park have not been confined to wheat. Since the year 1853 some portion of the farm has been devoted to testing the various merits of new artificial manures, and comparing their cost and yield with the old established ones; also in endeavouring to furnish some data for the quantity which can be successfully applied, and the state in which they should be deposited in the land. From these experiments an important fact or two may be considered proved. The first is, that excessive doses of artificial manure for roots are useless, and that from 3 to 4 cwt. of superphosphate is quite as much as need be applied. Another point which at first appears equally clear is not so successfully demonstrated. The trials of 1853 tend to show that with the water-drill half the quantity of artificial manure will produce as much, if not more weight, than a double dressing with the dry-drill. But the force of this is rather weakened by the experiments of the following year, for there it seems that 3 cwt. of superphosphate, whether applied dry or wet, produced nearly as much as 6 cwt. One caution in the use of guano with the water-drill may not be out of place here. Mr. Coleman says—" Do not by any means use guano unless in very small quantities. I am sorry to say that in one season I spoiled nearly all my beets by the use of 1½ cwt. per acre; although 1 cwt. did not affect swedes so much, still it is very dangerous to use in a liquid state." He goes on to say—" I consider the liquid-drill will be invaluable in a *dry* season, as sufficient water may be sown to bring the turnips up in the driest years;" and there can be no doubt that water distributes the manure more evenly than any amount of ashes. Mr. Coleman continues—" It depends in a great measure upon the distance that water has to be carted as to the expense; I do not find it takes much more labour than by the old process, as by sowing the seed with the manure we save the horses that were used in the broadcast manure distributor, so that the extra cost is not so very much," and the cartage and trouble of making and mixing ashes are also done away.

Another noticeable point is, that the dry season of last year produced a wretched crop of roots. It will be seen by these experiments that the growth of swedes at Holkham was but little more than half what was produced the previous year, and this coincides with the previously expressed opinion that the turnip crop of 1857 in Norfolk was the worst that had been known for many seasons. With regard to the relative value of the different superphosphates, the result of the Holkham experiments must not be regarded as entirely conclusive. Mr. Coleman, in his valuable remarks which are appended to last year's trials, refers to some *hints* that had been thrown out about the superphosphate furnished by certain local manufacturers not being a fair specimen of the manure they generally supplied to the public. It is but right to say that these hints were pretty generally believed; but as the Holkham authorities have gone to the trouble and expense of having the manures analysed, it, of course, now rests with the farmer to see that the manure he purchases is as good as that provided for these trials. Any further observations would be superfluous; the results speak for themselves, and any little explanation that may yet

be required will be found in the note from Mr. Coleman which appears at the end of these experiments.

EXPERIMENTAL TURNIPS ON HOLKHAM PARK FARM, 1853.

No. of Experiment.	Description of Manure.	Quantity per Acre.		Cost.			Yield per Acre.	
		Bush.	pks.	£.	s.	d.	Tons.	cwt.
1	Packard's Manure	8	0	1	15	0	11	5
2	Stark's do.	7	1	1	14	11	12	13
3	Thurtell's do.	8	2	1	14	6½	15	10
4	Lawes' do.	7	0	1	15	0	16	8
5	Bones	8	0	1	15	0	13	0
	Rape-cake	2	0					
	Guano	2	0					
6	Guano	7	0	1	15	0	16	2
7	8 loads Farmyard Manure	..		1	16	0	11	10
8	Odam's Blood Manure	8	0	1	15	0	16	15

TURNIP MANURE EXPERIMENTS, 1854.

No. of Experiment.	Description of Manure.	Quantity.	Farmyard Manure.	Cost per Acre.		Yield.	
		lbs.		£.	s.	Tons.	cwt.
1	Guano	400	.. ..	2	0	18	4
		200	7 loads at 3/	2	1	19	10
2	Lawes's Manure	640	.. ..	2	0	18	6
		320	7 loads at 3/	2	1	23	0
3	Mynn's do.	750	.. ..	2	0	13	15
		375	7 loads at 3/	2	1	19	5
4	Potter's Guano	560	.. ..	2	0	12	3½
		280	7 loads at 3/	2	1	20	5
5	Packard's Manure ..	640	.. ..	2	0	16	5
		320	7 loads at 3/	2	1	20	4½
6	Odam's Blood do. ..	640	.. ..	2	0	17	6
		320	7 loads at 3/	2	1	21	16
7	Thurtell's do. ..	640	.. ..	2	0	18	3
		320	7 loads at 3/	2	1	21	16
8	Batchelor's do. ..	640	.. ..	2	0	19	1
		320	7 loads at 3/	2	1	20	6½

MANGOLD WURTZEL EXPERIMENTS, 1855.

Name of Manure.	Quantity of Manure per Acre.	Cost of Manure per Acre.			Yield of Roots per Acre.	
		£.	s.	d.	Tons.	cwt.
Farmyard Manure	12 loads	..			18	3
Batchelor's Superphosphate	6 cwt.	2	2	0	17	18
Mynn's Manure	6½ ,,	2	2	0	17	3
Carnes' Superphosphate	6½ ,,	2	2	0	16	9
Packard's ditto	6 ,,	2	2	0	18	0
Raw Sugar	13 stone	2	2	0	18	12
Rape-cake	6 cwt.	2	2	0	18	4½

Sown with Chandler's Liquid Manure Drill, 3rd May, 1855 :—340 *Gallons per Acre.*

Swede Turnip Experiments, 1855. (Sown as usual with Dry Drill.)

Name of Manure.	Quantity of Manure per Acre.	Cost of Manure per Acre. £.	s.	d.	Produce of Roots per Acre. Tons.	cwt.
Batchelor's Superphosphate	6 cwt.	2	2	0	14	8
Packard's ditto	6 ,,	2	2	0	11	5
Carnes' ditto	6½ ,,	2	2	0	14	0
Mynn's ditto	6½ ,,	2	2	0	10	0
Matthews' Nitrophosphate	6 ,,	2	2	0	14	8
Lawes' Superphosphate	6 ,,	2	2	0	13	12
Thurtell's ditto	6 ,,	2	2	0	13	15
Peruvian Guano	3½ ,,	2	2	0	16	6
Natural produce of Soil without any Manure	..		..		7	2
Farmyard Manure	7 loads		..		20	1½
Thurtell's Superphosphate	3½ cwt.	1	4	6		

Swede Turnip Experiments, 1855. (Dry Drill *v.* Water Drill).

Name of Manure.	—	Quantity of Manure per Acre.	Cost of Manure per Acre. £.	s.	d.	Produce of Roots per Acre. Tons.	cwt.
Odam's Blood Manure or Nitrophosphate	Dry Drill	6 cwt.	2	2	0	13	14½
ditto ditto ..	Water Drill	3 ,,	1	1	0	15	0
Matthews' Nitrophosphate	Dry Drill	6 ,,	2	2	0	13	15
ditto ditto ..	Water Drill	3 ,,	1	1	0	13	10
Batchelor's Superphosphate	Dry Drill	6 ,,	2	2	0	14	15
ditto ditto	Water Drill	3 ,,	1	1	0	15	15
Lawes' Superphosphate ..	Dry Drill	6 ,,	2	2	0	14	6½
ditto ditto ..	Water Drill	3 ,,	1	1	0	14	5

Sown 14*th June*, 1855:—*quantity of water used with Water Drill*, 240 *Gallons per Acre.*

Swede Turnip Experiments, 1856. (The Manure sown in a dry state.)

No.	Name of Manure.	Quantity of Manure per Acre.	Cost of Manure per Acre. £.	s.	Yield of Roots per Acre. Tons.	cwt.
1	Batchelor's Superphosphate	6 cwt.	2	2	20	12
2	Lawes' ditto	6 ,,	2	2	20	16
3	Thurtell's ditto	6 ,,	2	2	20	17
4	Packard's ditto	6 ,,	2	2	20	14
5	Simpson's Nitrophosphate	5 ,,	2	2	21	10
6	Brown's Superphosphate	6 ,,	2	2	22	0
7	Baly's ditto	6 ,,	2	2	20	12
8	Odam's Blood Manure	6 ,,	2	2	19	12
9	Peruvian Guano	3½ ,,	2	2	21	3
10	Farmyard Manure	12 loads	2	2	22	10
11	Farmyard Manure .. .. / Batchelor's Superphosphate	6 loads / 3 cwt.	21s. / 21s. } 2	2	22	13
12	Simpson's Nitrophosphate	2½ cwt.	1	1	21	0
13	Batchelor's Superphosphate	3 ,,	1	1	19	14
14	Lawes' ditto	3 ,,	1	1	20	10
15	Natural produce of Soil without any Manure	Nil.	..		13	0

Swede Turnip Experiments, 1856. (The Manure sown with Chandler's Liquid Manure Drill. 240 gallons of Water per Acre.)

No.	Name of Manure.	Quantity of Manure per Acre.	Cost of Manure per Acre.			Yield of Roots per Acre.	
			£.	s.	d.	Tons.	cwt.
16	Lawes' Superphosphate	3 cwt.	1	1	0	19	10
17	Batchelor's ditto	3 ,,	1	1	0	18	15
18	Simpson's Nitrophosphate	$2\frac{1}{2}$,,	1	1	0	21	10
19	Lawes' Superphosphate	6 ,,	2	2	0	20	17
20	Batchelor's ditto	6 ,,	2	2	0	18	14
21	Simpson's Nitrophosphate	5 ,,	2	2	0	20	3
22	Guano (sown dry) .. .. Simpson's (with water drill)	$1\frac{1}{2}$ 19*s.* $1\frac{1}{2}$ 12*s.* 6*d.*	1	11	6	21	12

Swede Turnip Experiments, 1857. (The Manure sown in a dry state.)

No.	Name of Manure.	Quantity of Manure per Acre.	Cost of Manure per Acre.			Quantity of Roots per Acre.	
			£.	s.	d.	Tons.	cwt.
1	Batchelor's Superphosphate	6 cwt.	2	2	0	11	14
2	Lawes' ditto	6 ,,	2	2	0	12	6
3	Thurtell's ditto	6 ,,	2	2	0	11	7
4	Starks' ditto	6 ,,	2	2	0	13	4
5	Simpson's Nitrophosphate	6 ,,	2	2	0	12	18
6	Brown's Superphosphate	6 ,,	2	2	0	13	11
7	Economical Manure	$3\frac{1}{4}$,,	2	2	0	8	11
8	Wool Manure	6 ,,	2	2	0	12	14
9	Peruvian Guano	3 ,,	2	2	0	12	16
10	Bones	13 bushels	2	2	0	11	18
11	Bones and Guano, equal parts ..	..	2	2	0	11	18
12	Bones and Simpson's ditto	..	2	2	0	13	9
13	Guano and Simpson's ditto	..	2	2	0	12	9
14	Natural produce of Soil without any Manure	..		..		6	0

Swede Turnip Experiments, 1857. (With various quantities of Batchelor's Superphosphate.)

No.	Manure.	Quantity of Manure per Acre.	Cost of Manure per Acre.			Quantity of Roots per Acre.	
			£.	s.	d.	Tons.	cwt.
1	Batchelor's Superphosphate	1 cwt.	0	7	0	7	7
2	ditto ditto	2 ,,	0	14	0	9	17
3	ditto ditto	3 ,,	1	1	0	10	16
4	ditto ditto	4 ,,	1	8	0	11	7
5	ditto ditto	5 ,,	1	15	0	11	16
6	ditto ditto	6 ,,	2	2	0	12	0
7	ditto ditto	7 ,,	2	9	0	12	7
8	ditto ditto	8 ,,	2	16	0	12	1
9	ditto ditto	9 ,,	3	3	0	12	11
10	ditto ditto	10 ,,	3	10	0	12	0

ANALYSIS OF MANURES.

By J. C. NESBIT, Kennington Lane, London.

—	Simpson.	Starks.	Batchelor.	Lawes.	Wool Manure.	Brown.	Economical.	Thurtell.
Moisture	10·60	10·60	11·50	14·00	18·60	14·60	10·80	19·50
Organic Matter	16·22	16·75	13·02	16·14	19·57	14·0	19·34	13·45
Insoluble Matter	6·10	8·90	14·80	8·90	9·80	5·80	9·60	8·80
Oxide of Iron and Alumina	3·05	2·50	3·40	3·00	2·80	1·55	7·30	2·90
Soluble Phosphate	9·42	7·71	4·26	9·38	1·69	4·09	0·29	6·43
(equal to Neutral)	(14·70)	(12·03)	(6·65)	(14·63)	(2·63)	(6·38)	(0·42)	(10·03)
Insoluble Phosphate	13·24	24·19	30·67	20·77	31·97	27·98	0·12	5·28
Chloride of Sodium	..	0·75	..	..	1·46	3·98	25·00	0·94
Hydrated Sulphate of Lime, &c.	41·37	28·60	22·35	27·81	14·11	28·00	27·55	42·70
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Neutral Phosphate made soluble	14·70	12·03	6·65	14·63	2·63	6·38	0·42	10·03
Ditto ditto insoluble	13·24	24·19	30·67	20·77	31·97	27·98	0·12	5·28
TOTAL	27·94	36·22	37·32	35·40	34·60	34·36	0·54	15·31
Nitrogen (equal to)	0·42	0·78	0·28	0·35	2·96	1·06	0·07	0·28
Ammonia	0·51	0·94	0·34	0·43	3·59	1·28	0·09	0·34

Incomplete as the foregoing experiments are, they serve to show that an unlimited quantity of artificial manure is unnecessary, and that the larger the quantity used the less proportionate return is there for the outlay.

The experiments would have been much more numerous had not many of the plots been so much injured by the "fly," that they were not considered satisfactory, and therefore have been omitted.

The analysis of the various manures used has been obtained at considerable expense from a chemist whose name is well known to all agriculturists; and as it has been hinted that manufacturers, knowing their manures were to be tested against others, had taken care to have them made on purpose for the trial, it now rests with all purchasers of the manures used in these experiments to decide whether they choose to receive an inferior article, or whether, by compelling the makers of the various manures to guarantee what they sell to correspond with the analysis here given, they will prevent unprincipled manufacturers from unduly obtaining patronage.

I hope that farmers will avail themselves of this, as the cost of analysis is very trifling compared with the loss arising from the use of the worthless trash sold under the name of superphosphate of lime.

Being aware that results will vary upon different soils, and under different management, I shall feel obliged to any of my agricultural friends who will inform me of any experiments they may have tried, and of their success. The soil upon which these experiments have been carried out is very light upon a chalky subsoil; the previous crop, wheat; and the land in a good, but not very high, state of cultivation.

I trust that agriculturists generally, and those of West Norfolk more particularly, may derive some benefit from these experiments, which, slight as it may be, will amply repay me for what little trouble I have had in carrying them out.

JOHN COLEMAN, Jun.

Longlands, Holkham.

XIV.—*Report on the Exhibition and Trial of Implements and Machinery at the Chester Meeting.* By Sir A. K. MACDONALD, Bart., Senior Steward.

THE Report of the Judges on "the Steam-plough or Cultivator" having already been made public, it would have been desirable to have published the Reports of the other Judges of Implements in the last number of the Journal, but unfortunately one very important Report was not received till after the Journal was in circulation.

For the information of those who were not present at Chester, it may be necessary to mention that immediately below the walls of that ancient city a beautiful meadow of about 84 acres extends to the borders of the river Dee: this meadow is known

by the name of the "Roodee," and there the Royal Agricultural Society of England pitched their 25 acres of canvas and held their annual meeting in the month of July, 1858.

The Prizes offered by the Society at Chester—with the exception of the 500*l.* Prize for Steam Cultivation—were confined exclusively to those implements and machines applicable to "the conversion of farm produce," forming the third division of agricultural machinery admitted to competition at the Society's meetings within the last three years, the Prize List at Chelmsford in 1856 having been devoted to implements for "the preparation of the soil," and that at Salisbury in 1857 to those for "the treatment of the crop from sowing to gathering."

It will appear that the competing implements and machinery at this meeting comprised those of the most important and costly character, and the trials possessed features of unusual interest, partly in consequence of the steam-engines and threshing-machines not having been publicly tested since the Carlisle Meeting in 1855, and partly from a general impression that the prize for steam cultivation, so long withheld, would now, in all probability, be awarded.

The entries included:—

Steam-engines	112	Linseed-crushers	72
Threshing-machines	88	Oilcake-breakers	84
Corn-dressing machines	68	Bone-mills	13
Chaff-cutters	197	Turnip-cutters	67
Grinding-mills	63	Root-pulpers	103
And Churns	93.		

According to the old system this formidable list would also have comprised ploughs, harrows, cultivators, drills, &c., thereby entailing an amount of business which could not have been accomplished within the allotted period to the satisfaction either of the judges, the exhibitors, or the public; so that the advantage of, or rather the necessity for, triennial trials is very evident.

Business commenced on Tuesday, the 13th of July—one week previous to the admission of the public to the implement-yard—in one of the trial fields on the farm of Mr. Nichols, with the Steam Cultivators. The Judges appointed to conduct this trial were—Professor John Wilson of Edinburgh, Messrs. John Clarke of Long Sutton, Joseph Druce of Eynsham, and George Shackel of Earlsley Court, assisted by Mr. Amos, the consulting engineer, and his staff.

The Council having decided that a plough moved by steam-power might be considered to be a steam cultivator, all doubt as to the precise meaning conveyed by the wording of the Prize-sheet was removed.

Mr. J. Fowler, jun., of London, competed with his steam-

plough; Messrs. J. and F. Howard, of Bedford, with Smith's patent apparatus, consisting of cultivators and ploughs; and Mr. Thomas Ricketts, of Buckingham, also brought his very ingenious rotary steam-cultivator to the trial-ground. These three implements occupied the attention of the Judges till dusk.

On the following morning the trials were resumed, when Mr. Boydell, of London, with his well-known traction engine, appeared in the field, but for reasons stated in the Judges' Report he was not considered as a competitor.

Mr. Ricketts having now withdrawn his cultivator, the contest lay between Messrs. Fowler and Howard, and it was determined to continue the trials on heavier land.

Through the kindness of Mr. Humble we succeeded in obtaining the use of a 35-acre field on Blacon Farm, which could scarcely be considered heavy land; such as it was, however, we were obliged to make the best of it, and, having measured off 10 acres to each competitor, the trials were here brought to a conclusion the following day.

The very able Report of the Judges leads inevitably to the conclusions at which they arrived, viz. "that Mr. Fowler was fully entitled to the prize of 500*l*.," and their award was unanimously confirmed at the Meeting of the Council of the Society on the 4th August, 1858.

The trial of Steam-engines commenced on Wednesday, the 14th July, under the superintendence of the Engineer Judges, Messrs. William Owen, Edward Wards, and Benjamin Fothergill; Mr. Amos, Mr. Easton, jun., and their assistants, taking charge of the dynamometer and breaks.

The labours of these gentlemen were not brought to a close until the evening of Monday, the 19th; during which lengthened period the trials were conducted with the greatest care and with the utmost strictness.

In one instance an over-zealous engine-driver was detected in the act of appropriating a handful of cinders, in order to prolong the spark of life in his expiring engine; the consequence of this was, that the culprit was immediately tried by a sort of drumhead court-martial, and expelled the yard.

The recommendations contained at the close of the Engineer Judges' valuable Report deserve the immediate attention of the Society.

On entering the show-yard at Chester the visitor's direct path to the stock and implements lay through an avenue of steam-engines, neatly arranged at equal distances, their fly-wheels in perpetual motion, presenting a very animated scene; but what would have been the effect produced on the visitor's nerves had

be known that three of these steam-engines were liable to burst at any moment? It is hardly necessary to say that the Stewards, on being informed, by one of the Judges, of this serious fact, immediately ordered their fires to be extinguished; and the police had strict injunctions to remove any man from the show-yard who should attempt to get steam up in a dangerous engine.

By desire of the Judges the Stewards ordered the exhibitors of *eleven other engines* to limit their pressure to 45 lbs. per square inch; which caution would not have been required had they been entirely free from danger.

The safety of the public, and more especially the safety of the unfortunate purchasers of these worthless steam-engines, demands that a rule shall be made and strictly enforced to the effect that "no manufacturer can be allowed to get steam up in his engine in the Society's yard until the boiler has been previously examined by the Judges or the Society's engineers, and a certificate of fitness obtained."

The trials of Threshing-machines were undertaken by Messrs. John Clarke, George Shackle, and Thomas H. Barker, on Thursday, the 15th of July, and terminated on the evening of Wednesday, the 21st.

To facilitate their very arduous task, a tabulated statement of performances, drawn up by Mr. J. A. Clarke, was adopted by the Judges. The dynamometer was under the control of Mr. Appold and Mr. Amos, jun.

The Judges' Report on these important trials will be found so ample in its details, and so admirably arranged, as to require no remark in this place.

Possibly many readers of these Reports may have stood within two yards of a threshing-machine working its hardest for an hour or two; but if any reader will kindly continue this experiment for twelve or fourteen hours *on six consecutive days*, he will then be able to form a tolerable idea of the labours undergone by the Judges of threshing-machines at the Chester Meeting.

The Stewards regret extremely that these gentlemen were so overworked, and are greatly obliged to them for having gallantly carried through the duty they undertook with so much assiduity and good humour.

The merits of the Chaff-cutters, Root-cutters, Root-pulpers, Linseed-crushers, Oilcake-breakers, Winnowing-machines, Corn-dressing machines, and Cheese-making apparatus, were adjudicated upon by Professor Wilson, Mr. Joseph Druce, and Mr. John Hicken, whose Report bears testimony to the great care and attention bestowed on these trials.

Last, but not least, in this collection of excellent Reports

appears that of Mr. Fielder King and Mr. Charles Willsher, who undertook the duty of judging the Bone-mills, Grinding-mills, Churns, Cheese-pressers, and miscellaneous implements. Whatever difficulty these gentlemen may have encountered in making their miscellaneous awards, no implement in the yard appeared more deserving of a silver medal than Rowley's Blast Drill for destroying the fly on the turnip crop, which has been particularly destructive in many parts of England this season.

Having called attention to all the Reports, it becomes the duty of the individual who acted as Senior Steward at Chester to return his best thanks to the Judges for the kindness they showed to him individually, and for the zeal which they evinced in the discharge of their arduous duties.

The Stewards were of opinion that the Judges generally had more work thrown upon their hands at this great meeting than they could accomplish without exerting themselves to an unreasonable extent; but this they did, and their work was not only done, but admirably well done, for which they deserve the thanks of the Society.

On future occasions the number of Judges should be proportioned to the number of entries for trial, or great difficulty will be found in inducing men of eminence in their profession to undertake this honourable but arduous office.

The accommodation provided for the Judges by the Society was thoroughly appreciated by them, and lightened their labours considerably; if their comfort, as formerly, had been entirely uncared for, they would not have had the opportunity of getting through a vast deal of business in the evenings, the trials would have been prolonged beyond the limits of endurance, "urgent private affairs" would have called most of them to their homes, and the Stewards would have looked in vain for awards or reports.

The few observations which the Senior Steward has taken the liberty of making have occupied much more space than they are worth, and he must conclude by tendering the warmest thanks of his colleagues and himself to the Mayor of Chester, Mr. Humberston, for his courtesy, hospitality, and successful endeavours to render them every assistance.

The Stewards were also under great obligations to Mr. Chivas and the gentlemen of the Local Committee.

In saying farewell to his brother Stewards the writer of this Report will only express his sincere hope that they may be as fortunate in their colleagues as he has been, that they may meet with the same kind feeling on the part of Judges and Exhibitors as he has met with, and that they may be able to record the proceedings of future meetings of the Royal Agricultural Society rivalling that of Chester in 1858.

Steam Engines.

We have the honour to report to you the observations made by us on the trials of Fixed and Portable Steam-engines at the meeting of the Society held at Chester in July last.

Eight-horse Portable Steam-Engines.—(*See* Table I., p. 317.)—We awarded the first prize to Messrs. Tuxford and Sons, of Boston. The workmanship was of excellent quality, and the consumption of fuel low.

The workmanship of the engine of Messrs. Clayton and Shuttleworth, of Lincoln, to whom we awarded the second prize, was equally good. This engine was second in consumption of fuel.

We highly commended the engine of Messrs. Hornsby and Sons, of Grantham. In consumption of fuel it was third in order, whilst the arrangement of the engine and quality of workmanship were such as entitled the makers to great credit.

We commended the engines of Messrs. Ransome and Sims, of Ipswich, and Messrs. Brown and May, of Devizes, as being of a good, serviceable, and economical construction.

Table II. (p. 318) exhibits the performance of the 8-horse engines with the coal of the district.

Twelve-horse Portable Steam-Engines.—(*See* Table III., p. 318.)—Our award of the first prize to Messrs. Hornsby and Sons, of Grantham, was determined mainly by the quality and design of their engine.

Its arrangements were of a superior description, and the details of its fixed and working parts exceedingly well proportioned. Though this engine is somewhat more costly than the rest, we found that the excess in price was occasioned by the use of materials of better quality, tending to promote durability in the engine and to lessen the cost of repairs.

The engine worked up to its full power (12-horse) at a less pressure of steam than the others, and is better fitted for the variable service required from it on the farm by reason of its possessing fuller command over its work.

We believe that the advantage possessed by the other engines in respect to their lower consumption of fuel would be found to disappear in actual service, when the appliances for reducing the area of their fire-grates would be removed. The fire-grate of Messrs. Hornsby and Sons' engine was in its ordinary state.

We highly commended Messrs. Tuxford and Sons' engine, on account of the excellent quality of its workmanship and its favourable performance.

We also highly commended the engine of Messrs. Ransome and Sims, who have succeeded in making a very cheap engine which performed its work well.

Many parts of this engine are made of cast-iron which in others are made of wrought-iron and brass. The rims and tires of the wheels, the slides, slide-bars, and cross-heads are of cast-iron.

We considered the engine of Messrs. Clayton and Shuttleworth well entitled to be highly commended, the cost being moderate, and workmanship, material, and performance very good.

Fixed Engines.—(*See* Table IV., p. 319.)—We awarded the first prize to Messrs. Barrett, Exall, and Andrewes, of Reading.

This engine was lowest in consumption of fuel. Its workmanship was very good and construction simple.

We awarded the second prize to Messrs. Hornsby and Sons, of Grantham, the design and workmanship being very good and consumption of fuel low.

The engines of Messrs. Ransome and Sims, and of Messrs. Clayton and Shuttleworth, were simple, serviceable, and well made.

TABLE I.—EIGHT-HORSE PORTABLE STEAM-ENGINES.

Results of Performances.

Makers' Name.	Horse Power.	Stand.	Article.	Price.	Coals.		Time getting up Steam.	Actual time Running.		Mechanical time Running.		Weight on Break, inclusive of Constant.	Revolutions.		Coals per Horse-power per Hour consumed.	Remarks.
					1st Exp.	2nd Exp.		1st Exp.	2nd Exp.	1st Exp.	2nd Exp.		1st Trial.	2nd Trial.		
		No.	No.	£.	lbs.	lbs.	Min.	Min.	Min.	Min.	Min.	lbs.	No.	No.	lbs.	
Tuxford and Sons	8	159	1	245	39	112	60	10·	215	8·694	214 6	140·32	1220	30,120	3·914	1st Prize of 25*l*.
Clayton, Shuttleworth, and Co.	8	54	4	235	20·5	112	41·5	8·5	187·75	8·00	182·22	135	1079	24,600	4·611	2nd Prize of 10*l*.
Hornsby and Sons	8	47	2	225	19·5	112	46	10	153	7·853	159·87	140·32	1102	22,432	5·255	Highly commended.
Brown and May	8	82	1	230	41·5	112	45	15	154	14·42	159·45	134·71	1921	21,480	5·269	Commended.
Ransomes and Sims	8	6	2	235	37	112	42	8	162	5·295	154·815	150·89	799	23,360	5·426	Ditto.
James Haywood, jun.	7	1	1	215	32	98	63	10	120	9·76	118·95	138·21	1350	16,443	7·063	
Fowler and M'Collin	7	86	1	180	35·5	98	48	7	110	6·56	104·45	132·85	872	13,879	8·04	
William Foster	7	137	1	210	40·5	98	55	4	87	3·045	94·50	142·50	434	13,473	8·88	
William Clay	7	132	1	220	35·5	98	48	6	83	5·712	87·847	121·13	692	10,641	9·56	
Oliver Maggs	8	118	1	200	41·5	112	43	6·5	108	4·95	87·368	147·41	730	12,879	9·615	
William Butlin	6	18	1	210	46	98	64	7	82	5·236	74·75	129·28	677	9,664	11·245	

TABLE II.—EIGHT-HORSE PORTABLE STEAM-ENGINES.

Results of Second Trial with Common Coal.

Makers' Name.	Horse Power.	Stand.	Article.	Price.	Coals.		Time getting up Steam.	Actual time Running.		Mechanical time Running.	Weight on Break, inclusive of Constant.	Revolutions.		Coal per Horse-power per Hour consumed.
					1st Exp.	2nd Exp.		1st Exp.	2nd Exp.	2nd Exp.		1st Trial.	2nd Trial.	
		No.	No.	£.	lbs.	lbs.	Min.	Min.	Min.	Min.	lbs.	No.	No.	lbs.
Tuxford & Sons	8	159	1	245	56	112	67	17	178	206·841	140·32	2406	29,024	4·061
Clayton, Shuttle-worth, & Co.	8	54	4	235	34·5	112	31·5	12	169·5	169·2	135	1556	22,842	4·964
Hornsby & Sons	8	47	2	225	52	112	37	25	136	128·278	140·32	2645	18,000	6·548
Ransomes & Sims	8	6	2	235	37·5	112	46	11	139·5	143·004	150·89	1410	21,578	5·875

TABLE III.—TWELVE-HORSE PORTABLE STEAM-ENGINES.

Results of Performances.

Makers' Name.	Horse Power.	Stand.	Article.	Price.	Coals.		Time getting up Steam.	Actual time Running.		Mechanical time Running.		Weight on Break, inclusive of Constant.	Revolutions.		Coals per Horse-power per Hour consumed.	Remarks.
					1st Exp.	2nd Exp.		1st Exp.	2nd Exp.	1st Exp.	2nd Exp.		1st Trial.	2nd Trial.		
		No.	No.	£.	lbs.	lbs.	Min.	Min.	Min.	Min.	Min.	lbs.	No.	No.	lbs.	
R. Hornsby & Sons	12	47	1	360	49·5	168	37	8	137·5	7·247	144·733	155·5	1127	22,5[illegible]6	5·803	Prize of 25*l.*
Tuxford & Sons	12	159	3	350	53·5	168	57	8	174	7·156	175·08	139·88	1001	24,590	4·780	Highly commended.
Ransomes & Sims	12	6	1	300	34·5	168	63	11·5	153	9·929	149·128	152·68	1516	22,769	5·633	Ditto.
Clayton, Shuttleworth, & Co.	12	54	1	340	43	168	32	14	162	13·25	161·49	148·28	2653	23,947	5·200	Ditto.

TABLE IV.—FIXED ENGINES.

Results of Performances.

Makers' Name.	Horse Power.	Stand.	Article.	Price.	Fly-wheel. Revolutions per Minute.	Fly-wheel. Circumference.		Weight on Break, inclusive of Constant, $11\frac{1}{16}$ lbs.	Actual time Running.		Revolutions of Break-wheel.	Revolutions of Break-wheel for Mechanical Minute.	Mechanical Time.	Coals per Horse-power per Hour.	Remarks.
	.	No.	No.	£.	No.	Feet.	in.	lbs.	Min.	Sec.	No.	No.	Hours.	lbs.	
Barrett, Exall, & Andrewes	10	39	3	230	100	17	$11\frac{1}{2}$	$146\frac{9}{16}$	174	15	23,328	129·82	2·994	4·67	1st Prize 20*l.*
Hornsby & Sons	8	47	5	205	125	19	$1\frac{1}{2}$	$88\frac{1}{16}$	130	15	22,262	172·82	2·147	6·52	2nd Prize 10*l.*
Ransomes & Sims	10	6	3	275	80	18	11	$173\frac{13}{16}$	123	18	13,973	109·40	2·128	6·58	
Ferrabee & Co.	8	85	1	265	85	18	$10\frac{1}{2}$	$131\frac{5}{16}$	117	45	14,647	115·98	2·104	6·65	
Clayton, Shuttleworth, & Co.	8	54	13	200	110	19	0	$100\frac{13}{16}$	113	40	17,241	151·08	1·902	7·36	
E. & B. Johnson	10	57	1	240	120	17	3	$127\frac{3}{16}$	114	50	16,248	149·64	1·809	7·73	
Brown & May	8	82	2	190	120	17	$2\frac{1}{2}$	$102\frac{1}{16}$	103	58	16,139	149·28	1·802	7·77	
Oliver Maggs	8	118	4	200	130	15	$10\frac{1}{2}$	$102\frac{1}{16}$	95	40	15,285	149·19	1·707	8·20	
William H. Nash	8	74	2	200	80	18	10	$139\frac{13}{16}$	92	10	9,409	108·91	1·440	9·72	
Barrett, Exall, & Andrewes (2nd Trial)	10	39	3	230	100	17	$11\frac{1}{2}$	$146\frac{9}{16}$	159	30	21,642	129·82	2·778	5·04	

In concluding our Report we beg leave to suggest, as a condition to be observed in future trials, that steam-engines should not be considered qualified to compete for the prize unless they are constructed precisely as intended for sale. We have reason to believe that engines entered for trial are provided with special arrangements which the makers themselves regard as objectionable, and would dispense with in supplying their customers.

We would further desire to bring before your notice our view of the importance, in regard to safety, of a proper construction and staying of the boilers of the portable engines. In many of the boilers examined we found that this point had not received due consideration from the makers. We would especially recommend that every fire-box top should be furnished with roof-stays, that such stays should have a good bearing at their ends on the walls of the fire-box, and that the boiler ends should be secured by suitable longitudinal stays.

In many instances the form of the fire-box sides might be improved.

We would recommend that no manufacturer should be allowed to get steam up in his engine in the Society's show-yard until the boiler has been previously examined by the Judges or Society's engineer, and a certificate of fitness obtained.

It would be desirable also to lay down a general rule limiting the pressure of steam under which the boilers should be allowed to work.

Wm. Owen.
Edward Woods.
Benjamin Fothergill.

Steam Ploughs or Cultivators.

There were five competitors for the prize of 500*l.* offered by the Society for "the Steam Cultivator that shall in the most efficient manner turn over the soil, and be an economical substitute for the plough or the spade."

C. Burrell, of Thetford, sent the patent locomotive traction engine or steam horse, invented by James Boydell, of London, and manufactured by the exhibitor.

Wm. Crowley and Sons, of Newport Pagnell, entered a set of ploughs, invented, improved, and manufactured by themselves, consisting of three ploughs each way, connected together so as to work at one uniform depth over uneven surfaces, with an apparatus for expanding or contracting them to bring them on to new ground.

Thomas Ricketts, of Buckingham, sent his patent rotary steam cultivator, consisting of a 10-horse power locomotive engine with a horizontal shaft behind, driven by pitch chains and revolving in radial links in the direction contrary to that in which the wheels are travelling. On this shaft are placed tines, spades, or cutters of other forms, which enter the soil at the bottom of the furrow, cut upwards, and either break up or invert as required.

J. and F. Howard, of Bedford, sent a set of Smith's patent apparatus for cultivating land by steam power, invented by Wm. Smith, of Woolston, and manufactured by themselves. This consists of an ordinary 8-horse portable steam engine, with windlass, leather driving-band, wire ropes, pulleys, turning bow, ploughs, and cultivators, all complete for work.

And, lastly, J. Fowler, jun., of Cornhill, sent his steam plough, consisting of an ordinary 10-horse engine, with windlass to attach and detach, and anchor, with four-furrow balance plough frame, with scarifier tines to take the place of the plough mouldboard.

The trials were commenced on the 13th of July, in a field of two-year-old seeds, the soil a light sandy loam, upon a subsoil of silt or sand, the land having been reclaimed originally from the bed of the river Dee. The soil,

though naturally of a very light description, offered considerable resistance owing to its surface being firmly bound together by a luxuriant growth of couch and other grasses, and represented a fair trial ground for two-horse work. Indeed a dynamometrical experiment with one of Howard's PL ploughs, drawn by two horses, and taking a 6 by 10-inch furrow, showed that the resistance offered was equal to 32 stones, or 4 cwts.

From various causes the arrangements for working Boydell's engine were not completed within the time appointed for the trials; and although it was subsequently at work, exhibiting its great powers of traction, both with Coleman's cultivator and Williams' frame of ploughs attached, we are not able, for the above reason, to give any report upon its work or comparative merits.

The set of ploughs entered for trial by Crowley and Sons was unprovided with any motive power, which had to be supplied by Fowler's engine. This fact alone disqualified these exhibitors from taking part in a competition, the principal element of which was the *power*, and not the mere tool or implement by which the work was to be performed. On trial, however, the set of ploughs got deranged, and was at once withdrawn.

The rotary steam cultivator of Ricketts, although unsuccessful, demands more than a passing notice, as it contains many points well worthy of con-

RICKETTS' ROTARY CULTIVATOR.

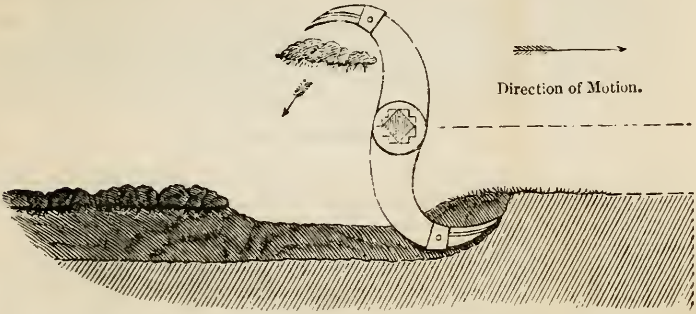
Side elevation, showing steerage and driving gear.

Ricketts' Cultivator, showing cultivating shaft ready for work.

sideration, especially by those who think a *locomotive* preferable to a *fixed* traction power, and a *rotary* to a *horizontal rectilinear* motion. The engine was of the ordinary locomotive construction, with double cylinders and reducing gear-work for driving one of the carrying wheels. It was steered by the fore-carriage, and three men were required when at work in the field. The principle of action in this cultivator is a horizontal transverse shaft, driven by an endless pitch chain from a pinion on the crank shaft, attached to the hind part of the engine, and revolving in radial links at a small elevation above the ground. The axis of this transverse shaft (on which several different forms of cutters were fixed according to the nature of the work required) is parallel to that of the engine wheels, but a *contrary motion* is given to it, so that the cut or passage of the implement through the soil is with the direction of the engine's progressive motion.

By this arrangement the cutters enter the soil or furrow from below, and, working upwards to the surface, carry with them the separated pieces, and drop them, as their revolution is continued, in an inverted position. This is a new principle of action in rotary cultivation: it substitutes a tearing for a compressing force in dividing the soil, and completes the inversion of the separated pieces by moving through half a revolution (or an angle of 180°) instead of three-quarters of a revolution (or an angle of 270°), which is required by the ordinary mode of applying rotating cultivators.

A considerable saving of power is thus effected, especially in strong and stony soils, and the soil itself is left in a more open and desirable state. The shaft can be elevated or lowered to suit any depth of cultivation required, and the length of the cut or furrow slice can be varied by change wheels on the crank and intermediate shafts.



Section of Ricketts' Cultivating Shaft when at work.

The field appointed for the trials was laid up in narrow lands, varying from 7 to 10 feet wide, with a difference of level of some 10 or 12 inches between the ridge and the furrow, and thus afforded no fair test of the powers of this rotary cultivator, as, owing to the great breadth of its cut (7 feet), in no part could it find space sufficiently level to show its work to advantage. Enough work, however, was done to establish its capabilities, to indicate several points in its working details which might be readily improved, and to show that the principle of rotary cultivation had taken a distinct position as a desirable and valuable addition to the Mechanics of Agriculture.

We think Mr. Ricketts deserves great commendation for the skill and ingenuity displayed in the design and arrangement of the rough trial-machine exhibited. The working details may be thus given:—While in motion on suitable ground the machine advances about 20 feet per minute, the shaft making 75 revolutions, and the tines or cutters attached taking a slice 4½ inches wide by 6 inches deep and 7 feet in breadth. At this rate 91½ poles per hour, or about 5¾ acres per day, would be performed. The working expenses per day may be taken at 1*l.* 15*s.* 9*d.*:* this, taking 4 acres as the average work done per day, would give about 9*s.* per acre as the cost of cultivation. Owing to the breaking of the chain driving the transverse shaft, the work was brought to a close during the first day, and the machine withdrawn from further competition.

Two competitors now only remained for our attention, Messrs. Fowler and Howards, both of whose machines and working arrangements are too well known to need any description here. It would be right, however, to observe

	£.	*s.*	*d.*
* Engineer	0	5	0
Two men, at 3*s.*	0	6	0
Coals	0	10	0
Oil, &c.	0	1	0
Water-cart	0	5	0
Interest 5 per cent., and wear and tear 15 per cent., on first cost, taking 200 as the number of working days per year ..	0	8	9
	£1	15	9

that Mr. Fowler's have been considerably simplified and improved since the last annual meeting of the Society, and that a very important diminution has been effected both in the traction power required and in the wear and tear arising from friction. The engine, too, and the windlass and anchor pulley are now self-moving, and, after being once fixed, travel through the field, however large, without any assistance whatever.

In testing the comparative merits of these two machines, we thought it best to direct our attention to—

1st. The cost of working per day.

2ndly. The quantity and description of work done.

3rdly. The practical or agricultural value of that work.

The trials were commenced in the field (light land) already described, and were continued the following days in a field on Blacon farm, where the soil was a tenacious loam in a very dry and indurated condition, and matted together on the surface by a strong growth of thistles and grasses.

An experimental trial with a Wilkie plough (swing) gave a dynamometrical result of 51 stones, or 6⅜ cwt., as the traction power required to turn a 6 × 9 furrow, thus showing it to be fully equal to a strong three-horse soil. The trials comprised ploughing on the light land, and ploughing and trenching with Cotgreave's ploughs on the strong land by Fowler's machine; while Howards exhibited Smith's system of cultivation by means of his spud-tined cultivator, and his subsoiling and trenching plough.

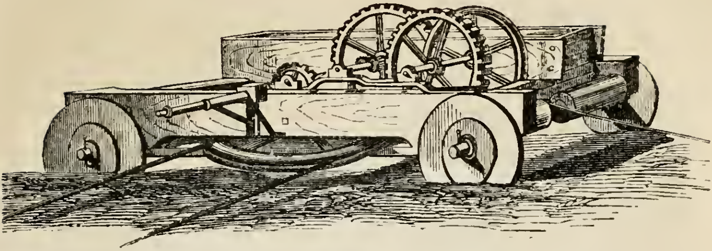
The daily working expenses of Fowler's machine we estimate as follows:—

	£.	s.	d.
Engineer	0	5	0
Plough and anchor men	0	6	0
Two boys	0	2	0
Water-carting	0	5	0
Coals, 10 cwt.	0	10	0
Oil, &c...	0	1	0
Removal	0	4	0
Interest at 5 per cent. and wear and tear at 15 per cent. on first cost (650*l.*), assuming 200 as the number of working days in the year	0	13	0*
	£2	6	0

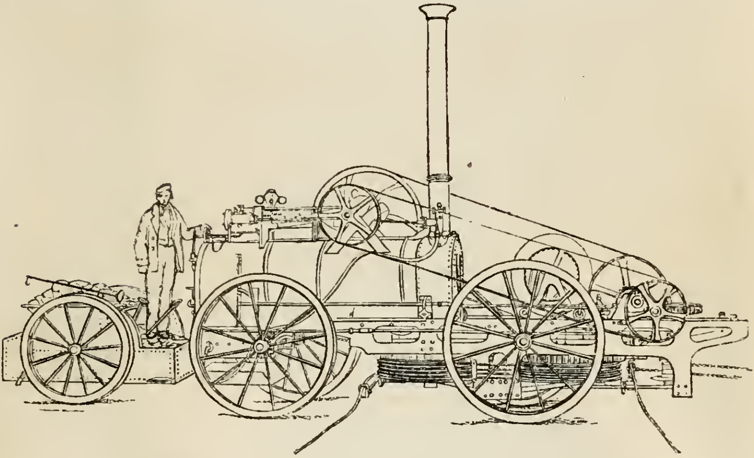
On the light land the work was performed, including stoppages, at the rate of 7¾ acres per day of 10 hours. The actual rate of travelling, while the ploughs were in full swing, was 3·83 ft. per second, which gives about 1·031 acres per hour, the soil moved (four ploughs) being 3 feet 4 inches wide by 6 inches deep.

On the heavy land 4 acres 3 roods 12 poles were ploughed in 9 hours 39 minutes, equal to 5 acres per day of 10 hours, the same sized furrows being taken. With Cotgreave's trenching plough the rate of work was, of course, greatly diminished. The furrow was 12 to 14 inches deep, while the width (two ploughs used) was 20 inches. About the same quantity of soil was removed

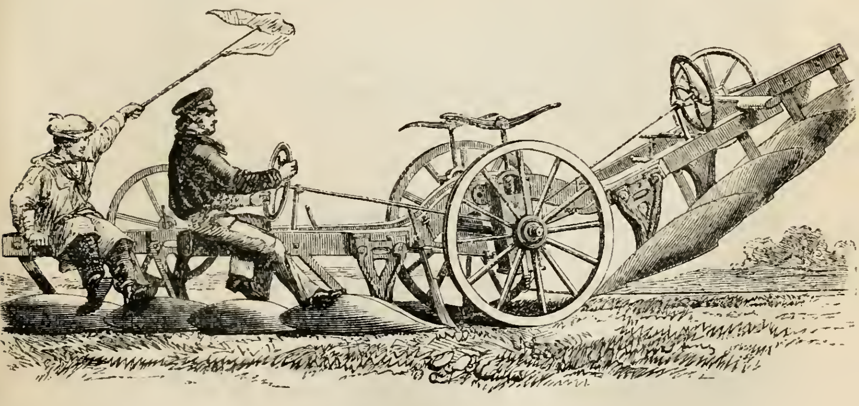
* It is right to mention that the cost of Fowler's apparatus complete, is 730*l.*, instead of 650*l.*, the price officially furnished to the Judges. This would, of course, occasion a small increase in the estimate of daily working expenses.



Fowler's Self-moving Windlass and Anchor Pulley.



Fowler's Engine



Fowler's Steam-Plough.

removed as by the other ploughs;* but a little more power was consumed. The work done was just 40 poles per hour, or $2\frac{1}{2}$ acres per day.

These results enable us to give the cost of ploughing by Fowler's machine—

	s.	d.
An acre of light land (according to rate of work done in trials) ..	6	0
Ditto ditto (taking 6 acres per day as the average) ..	7	2
An acre of heavy land	9	2
Ditto ditto (trenched)	18	4

Our estimate of the quality and value of the work thus performed is, that the light land could not have been done by horse power for less than 8*s.* per acre; that the heavy land could not have been ploughed by horse power for less than 12*s.* 6*d.* per acre; and that the trenching could not have been done by horse power at all; and that by manual labour with the spade and grafting tool it could not have been done for less than 10*d.* per pole, or 6*l.* 13*s.* 4*d.* per acre, and then only in a very inferior manner.

Smith's "system of cultivation," as exhibited by Messrs. Howard, requires two operations: the first with a strong spud-tined cultivator, which penetrates the ground to a given depth (in this case 6 to 7 inches), and tears it up, leaving the surface more or less in its original position; while the second, with a similar implement of larger dimensions, travelling in a transverse direction and at the same depth, clears away any portions unmoved by the first, and reverses the whole of the top soil, exposing a rough irregular surface to the action of the atmosphere.

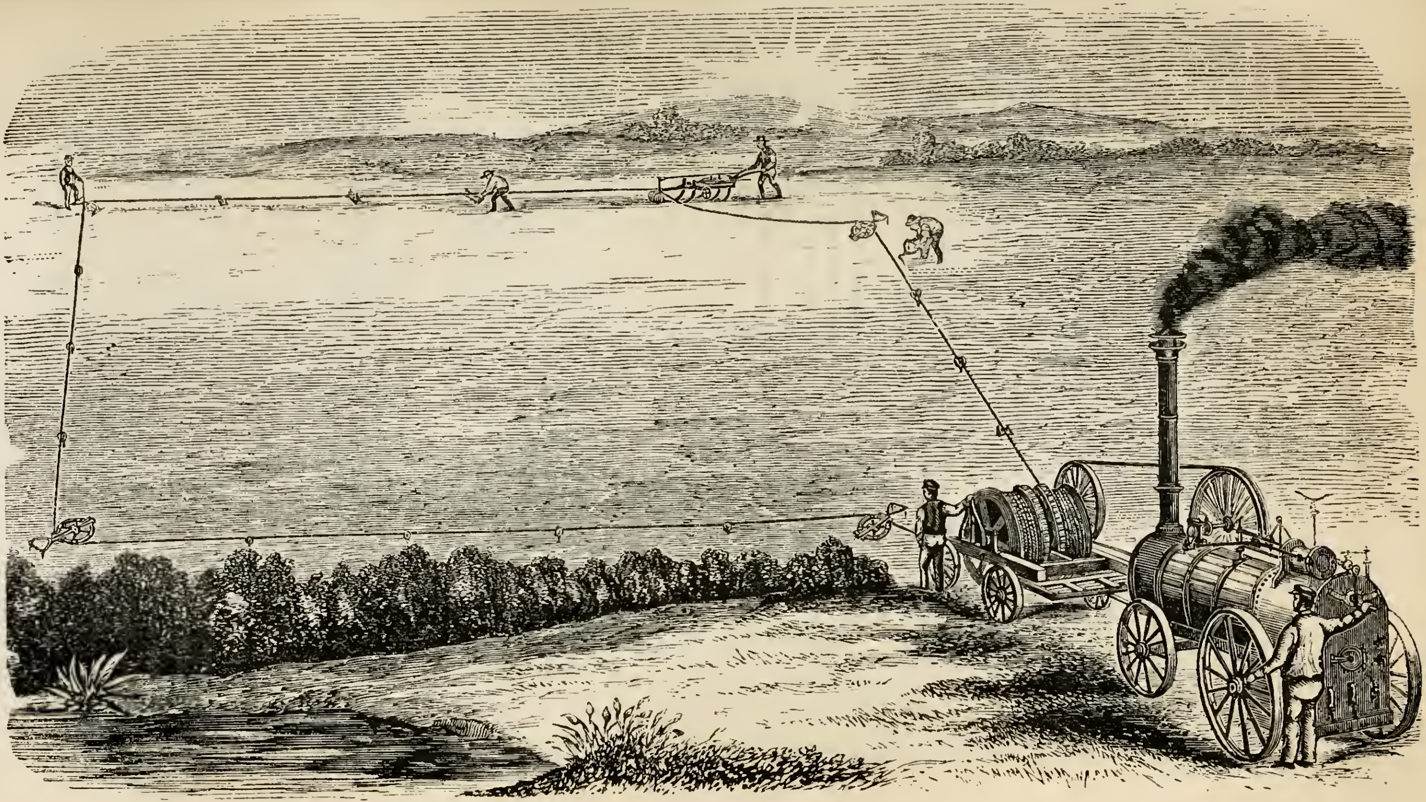
The principal trials took place on the heavy land at Blacon, when 4 acres 3 roods were gone over by the first operation with the smaller cultivator (3-tined, taking a breadth of 26 inches) in 10 hours 37 minutes. In the second operation (with the 5-tined cultivator, taking a breadth of 48 inches), 4 acres 3 roods 33 poles were finished in 4 hours 50 minutes, which, inclusive of stoppages, &c., gave a result of work completed by the two operations of about 5 acres in 15 hours, or $3\frac{1}{2}$ acres per day. The daily working expenses of this machine were estimated as follows:—

	£.	s.	d.
Engineer	0	5	0
Four men in field	0	10	0
Boy	0	1	0
Water-carting	0	5	0
Removal	0	4	0
Coals, 10 cwt.	0	10	0
Oil, &c.	0	1	0
Interest 5 per cent., wear and tear 20 per cent. on first cost (430*l.*), taking 200 as the number of working days per year ..	0	10	9
	£2	6	9

This shows that the work was done at a cost of 14*s.* per acre, while to effect a similar result with the ordinary implements and horse-power three distinct operations would be required, which could not be performed at less than 18*s.* 6*d.* per acre.

These money results, satisfactory though they be, are not, we consider, the

	Land moved. Breadth. Inches.	Depth. Inches.
* By ploughs	40 by	6
Cotgreave's trenching ditto	20 by	12



Smith's Steam Cultivator, manufactured and exhibited by Messrs. Howard.

only points of advantage which the introduction of these machines confers upon agriculture. By their aid we can carry out a complete system of autumnal cultivation now so generally admitted to be desirable, but which it is extremely difficult to effect with the ordinary force of a farm, in ordinary seasons, and under ordinary circumstances. We can continue our cultivation by ploughing or otherwise, well nigh regardless of weather, and upon land which would not bear the pressure of horse labour. We have perfect control over the work we wish to have done; and when it is done, it is found to be more regular throughout, and to be in a more open and desirable condition than could be obtained by the best and most judicious application of the ordinary implements of a farm. These are points which we cannot too strongly recommend to the attention of those interested in the advancement of agriculture.

We wish it to be distinctly understood that throughout the trials we have charged the machines with the *maximum of working expenses*, and have credited them with the *minimum value for the work performed.* We feel confident that, when in constant operation on a farm, the work done would be at a lower rate of cost than that now given, and their great advantages then more clearly and directly shown. At the same time, too, it must not be forgotten that the engines themselves are equally applicable to all the other power purposes of the farm.

From the foregoing results of the trials intrusted to our decision by the Council of the Royal Agricultural Society, and conducted throughout under our immediate supervision, it is beyond question that Mr. Fowler's machine is able to turn over the soil in an efficient manner at a saving, as compared with horse labour, on light land of 2½ to 25 per cent.; on heavy land 25 to 30 per cent.; and in trenching of 80 to 85 per cent.; while the soil in all cases is left in a far more desirable condition, and better adapted for all the purposes of husbandry. We are, therefore, unanimously of opinion that he is fully entitled to the prize of 500*l.*, and we make our award accordingly.

The results of the trials of Messrs. Howard's machine also prove that by it also the soil can be inverted in an efficient manner, and at a less cost than by horse or manual labour. We think, therefore, that some acknowledgment of its merits is due from the Society, and we beg to recommend for the consideration of the Council that a large gold medal of honour be presented to Messrs. Howard, " for the practical introduction of Smith's application of steam power to facilitate autumnal cultivation, now generally admitted to be desirable on all descriptions of soils."

The Council will be gratified to learn that already 23 of these machines have been sent out by the manufacturers, and that 20 of them are being successfully worked by tenant farmers.

Jno. Clarke, Long Sutton.
Joseph Druce, Eynsham, Oxon.
George Shackel, Earlsley Court, Reading
John Wilson, Edinburgh.

Thrashing-Machines.

This was unquestionably the most important trial of this kind of machinery ever undertaken. The number of entries far exceeded our anticipations, no less than eighty-nine machines of various powers being brought forward for trial, enough certainly to test our courage and physical powers. However, our labours as Judges were shared in common with the senior steward, Sir Archibald K. MacDonald, who, with his usual courtesy, was ever ready to aid us, and did all in his power to lighten our duties. Messrs. Appold and Amos, jun., worked the dynamometer throughout the trials with unre-

mitting attention, thus rendering our work much easier than it otherwise would have been. Having so much labour before us, and no little responsibility, we resolved to lay down a plan for facilitating the one, and arriving at something like a clear and definite conclusion relative to the other; and, as adjudication by a system of points had been long in use at the Society's trials, and its merits fairly brought out, we held a committee-meeting of such Judges as could conveniently be got together, and, after fairly canvassing the whole matter, finally agreed upon a series of points upon which to found our decisions. This was drawn out in a tabular form.

The Engineering Judges engaged to give their opinion upon the simplicity of construction and the goodness of workmanship of the machines brought before them, and to aid us still further we procured from the Show-yard two excellent machines—one from Messrs. Boby's stand, which perfects the samples in a way hitherto unknown, leaving us the separate products for examination, and at once showing us any defects in dressing the corn: the other, a chaff-dressing machine from Messrs. Howard's stand, which completely separates all grain and seeds from chaff and cavings; thus giving us a correct standard by which to try the performances of the class of combined machines on these points.

We, therefore, as Judges, had mainly to confine ourselves to the work done; and we found that, by attention and care, we were soon able to put down the proper number of points to which each machine coming before us was entitled in reference to the precise kind or department of work executed, and which the tabular sheet will, we think, show satisfactorily. It is perhaps superfluous to say that we *scorn utterly* any charge of partiality; but as, on reference to the tabular sheet or form, it will be seen that nearly all the prizes were awarded to one firm, we are desirous to affirm that it was not we as Judges that decided it, but the system itself, viz. the greatest number of points obtained for different orders of work, and for the excellence and quality of the machine. Having gone through all the competitive trials (many of the machines having been from various causes withdrawn), and seeing that the Engineering Judges were almost overwhelmed with work (having 105 steam-engines to test), we resolved to trouble them as little as possible, and agreed to take their judgment upon the four machines alone which were selected for the final trial; and further, that we would take their adjudication of points to these four as the standard by which we might adjust the points to the other machines brought for trial by the same makers. Consequently in our tabular form no points are given under the heads of excellency of workmanship or simplicity and durability to any other machines but those of these four manufacturers.

The competitive trials were conducted in a very simple way. The machines were subjected to a preliminary trial with 35 sheaves of wheat each (and subsequently, if desired, with 10 sheaves of barley). If this trial proved satisfactory, they were brought upon a platform, under a shed, and with Mr. Amos's dynamometer attached to them, worked by Hornsby's steam-engine: 150 sheaves of wheat were then dealt out to each as they were brought forward, and upon the thrashing of these sheaves they were adjudged, the dynamometer and its managers recording the time and power, the Judges allotting the proper number of points to the work done, and the chaff and finishing-machines, named above, proving the quality of the dressing. If upon this trial the manufacturer and Judges conjointly thought it desirable, the machine was submitted to the further trial of barley-thrashing in precisely the same way, but with the limited quantity of 50 sheaves; and many facts were thus elicited which it is highly desirable that the country should be acquainted with, and which the accompanying Tables will show.

Class VI.—For the best Portable Thrashing Machine to be

Name.	No. of Points indicating Perfection . .						100	70	70	70	50	50
	Stand.	Article.	Quantity of Sheaves.	Time.	Horse-power required per Minute.	Actual Horse-power.	Clean Thrashed.	Clean Dressed.	Clean Shaken.	Cavings free from Corn.	Chaff free from Corn.	Corn uninjured.
				m. s.								
Garrett and Sons	87	5	50	4 36	..	5	100	..	56	..	..	50
Ransomes and Sims . . .	6	5	50	6 45	..	6	100	..	63	..	..	40
Wallis and Haslam . . .	121	2	50	8 10	..	3	100	..	..	..	..	35
Weighell, John	104	1	50	8 55	..	4	100	..	42	..	..	5
Goucher, John	142	2	This machine, when on trial, from its bad construction broke one									

Class VII.—For the best Portable Thrashing Machine not exceeding

Ransomes and Sims . . .	6	6	75	5 7	17·52	3·13	60	..	63	..	..	50
Humphries and Co.. . .	41	1	75	6 0	15·05	2·5	80	..	63	..	..	50
Clayton, Shuttleworth, and Co.	54	16	75	4 0	18·74	4·68	100	..	63	..	..	50
Garrett and Sons . . .	87	7	75	5 33	38·05	7·1	80	..	63	..	..	50
Hornsby and Sons . . .	47	6	75	4 0	21·69	5·4	70	..	56	..	..	50
Barrett, Exall, and Co.. .	39	4	75	5 50	43·31	7·85	90	..	63	..	..	50

Class VIII.—For the best Portable Thrashing Machine that will prepare the

Ransomes and Sims . . .	6	7	150	10 45	60·58	5·8	80	56	63	63	50	40
Barrett, Exall, and Co.. .	39	5	150	11 48	81·43	7·	80	35	56	42	40	40
Humphries and Co.. . .	41	2	150	12 77	63·6	4·2	90	56	56	63	50	45
Smith and Co.	44	1	150	9 29	52·71	5·6	90	56	42	42	40	45
Clayton, Shuttleworth, and Co.	54	18	150	15 68	48·62	3·1	90	56	63	63	40	45
Garrett and Sons	87	8	150	11 28	86·33	7·6	80	56	63	63	40	45
Hornsby and Sons . . .	47	7	150	10 87	104·22	9·5	90	70	63	63	50	50
Holmes and Sons . . .	32	4	150	10 89	85·99	7·89	80	40	56	56	35	45
Tuxford and Sons . . .	159	11	150	12 0	86·33	7·19	80	28	49	56	45	35

worked by Horse-power not exceeding that of Six Horses.

Chaff free from Cavings. (20)	Chaff free from Seeds. (20)	Straw unbroken. (20)	Excellence of Workmanship, &c. (100)	Portability. (20)	Power. (100)	Price. (100)	Actual Price. £. s.	Remarks.
..	..	18	..	18	..	48	88 0	Machine and horse-gear are on two wheels each, which do not require removing when at work. The machine works lightly and steadily.
..	..	18	..	20	..	38	110 0	Machine on four wheels and very portable. The price and power required are great objections.
..	..	14	..	10	..	100	42 10	This machine is not conveniently arranged for removing; straw and corn badly separated. The maker's patent spherical brasses are well worthy of notice.
..	..	14	..	16	..	80	52 10	This machine is on four wheels, driving wheel for horse works misplaced, general arrangement not good, and attempts to do too much for power.

of the cast-iron beaters, and in consequence nearly caused a serious accident.

Eight-Horse power for Large Occupations, to be worked by Steam Power.

..	..	20	..	20	86	100	60 0	A small machine on two wheels only 5 feet high.
..	..	20	..	20	100	100	60 0	A light portable machine, with maker's own patent screen, on four wheels.
..	..	20	..	20	85	100	60 0	A light portable machine on four wheels with Humphries' patent riddle.
..	..	20	..	16	39	90	66 0	A strong useful machine, but too heavy.
..	..	20	..	20	69	114	52 10	A portable and well-made machine on four wheels, with the exhibitor's usual arrangement of parts.
..	..	20	..	20	34	66	90 0	

Corn for the finishing Dressing Machine, not exceeding Eight-horse Power.

20	..	20	..	18	80	76	108 0	Worked with one blower and two riddles; corn fairly dressed.
14	..	18	..	18	..	86	96 0	One blower and one riddle; oscillation great; riddle clogged.
20	..	20	..	20	76	100	83 0	One blower and one riddle; a complete little machine of great simplicity; separation of seeds good.
18	..	20	..	20	..	83	100 0	One blower and one riddle; a well-arranged machine; spring bars to regulate the shoe good.
20	..	20	..	18	100	83	100 0	One blower and two riddles; worked remarkably well and steady.
18	..	16	..	12	..	92	90 0	One blower and three riddles; oscillation considerable; the arrangements for dressing and sacking intricate.
20	..	20	..	18	46	87	95 0	Two blowers and two riddles; steady in work, all done well, many bearings, power required great.
14	..	18	..	16	..	92	90 0	One blower and one riddle; unsteady in work, complex in straps, separations indistinct.
18	..	18	..	18	..	92	90 0	One blower and one riddle; vibrates too much, riddle's space confined.

CLASS IX.—For the best Portable combined Thrashing Machine that

Name.	Stand.	Article.	Quantity of Sheaves.	Time.	Horse-power required per Minute.	Actual Horse-power.	Clean Thrashed.	Clean Dressed.	Clean Shaken.	Cavings free from Corn.	Chaff free from Corn.	Corn uninjured.
No. of Points indicating Perfection . .							100	70	70	70	50	50
				m. s.								
Haywood, James (Wheat) .	1	2	150	12 0	84·26	7·02	60	40	42	56	40	35
,, ,, (Barley) .	..	..	50	..	..	..	60	28	42	28	40	25
Ransomes and Sims (Wheat)	6	8	150	11 1	47·14	4·27	80	49	63	63	50	40
,, ,, (Barley)	..	..	50	..	..	..	70	49	63	63	50	40
Nalder, Thos. (Wheat) . .	21	1	150	9 16	84·23	9·19	90	42	42	42	50	40
Roby and Co. (Wheat) . .	22	3	150	12 55	62·7	4·99	60	42	56	42	40	40
Savory, James (Wheat) .	24	1	150	14 18	74·26	5·25	70	42	49	28	35	40
Holmes and Sons (Wheat)	32	3	150	9 96	80·99	8·12	100	35	63	63	50	30
,, ,, (Barley)	..	..	50	..	..	..	80	35	56	42	35	50
Barrett, Exall, & Co. (Wheat)	39	6	150	12 42	71·78	5·77	70	35	63	63	50	40
,, ,, (Barley)	..	..	50	..	..	..	80	28	56	28	40	40
Cambridge, Wm. (Wheat).	40	2	150	11 32	35·64	3·14	40	35	56	56	40	35
Humphries & Co. (Wheat)	41	3	150	13 44	60·4	4·34	90	49	63	56	40	40
,, ,, (Barley)	..	..	50	..	..	..	90	42	63	42	40	25
Clayton and Co. (Wheat) .	54	19	150	13 5	72·07	5·34	90	63	63	49	45	45
,, ,, (Barley) .	..	..	50	..	..	..	80	63	56	56	40	45
Fowler and Co. (Wheat) .	86	2	150	10 26	96·73	9·42	10	35	35	7	30	35
Garrett and Co. (Wheat) .	87	9	150	17 92	102·8	5·18	90	56	63	63	40	40
,, ,, (Barley) .	..	..	50	..	..	..	90	49	63	63	35	45
Hart and Gibbons (Wheat)	90	1	150	12 45	85·82	6·89	80	56	63	42	40	40
,, ,, (Barley)	..	..	50	..	..	..	70	35	63	49	40	45
Hornsby and Son (Wheat).	47	8	150	16 92	141·94	8·38	90	56	63	63	50	45
,, ,, (Barley).	..	..	50	..	..	..	90	49	63	63	40	40
Tuxford and Sons (Wheat)	159	12	150	14 1	104·28	7·39	60	42	42	35	45	40
,, ,, (Barley)	..	..	50	..	..	..	50	28	42	35	45	40
Gilbert (Wheat)	114	1	150	12 8	60·83	4·75	70	42	28	56	45	30
Foster (Wheat)	137	2	150	13 9	63·88	4·59	90	63	63	56	40	50
,, (Barley)	..	..	50	..	..	..	80	56	63	56	40	45

CLASS X.—For the best Fixed Combined Steam Thrashing Machine

Hornsby and Sons (Wheat)	47	9	100	5 86	74·35	12·6	90	70	63	63	45	50
Clayton and Co. (Wheat) .	54	21	100	7 8	43·53	5·58	80	70	63	63	45	50

CLASS XI.—For the best Fixed Combined Steam Thrashing Machine

Garrett and Sons (Wheat) .	87	10	200	13 3	113·6	8·3	100	63	70	70	50	45
,, ,, (Barley) .	..	..	100	7 28	..	..	80	63	63	63	50	45
Hornsby and Sons (Wheat)	47	10	200	13 34	135·63	11·7	90	70	70	70	45	45
,, ,, (Barley)	..	..	100	6 92	..	..	90	63	63	63	45	40
Clayton and Co. (Wheat) .	54	20	200	14 0	118·42	8·45	100	70	70	70	50	50
,, ,, (Barley) .	..	..	100	4 85	..	..	100	70	63	63	50	45
Barrett and Co. (Wheat) .	39	7	200	14 83	138·0	9·3	90	56	56	63	45	45
,, ,, (Barley) .	..	..	100	..	..	..	100	42	56	42	35	45

will prepare the Corn for Market, not exceeding Eight-horse Power.

Chaff free from Cavings.	Chaff free from Seeds.	Straw unbroken.	Excellence of Workmanship, &c.	Portability.	Power.	Price.	Actual Price.	Remarks.
20	20	20	100	20	100	100		
18	8	20	..	14	..	84	110 0	Lost much time in testing an imperfect machine.
..	..	..	..	..	..	..	..	
20	18	20	86	18	80	76	130 0	Worked admirably without oscillation, all nicely balanced.
..	..	..	..	..	..	..	..	
18	8	18	..	16	..	84	110 0	Worked unsatisfactorily; had no trial of barley.
14	8	20	..	16	..	84	110 0	The elevators too near the ground; had no trial of barley.
16	8	20	..	18	..	93	100 0	General arrangement not good; a somewhat mistaken attempt at great simplicity.
16	8	10	..	16	..	88	105 0	Blowers and elevators awkwardly placed. Was tried in barley in Class VIII.
..	..	..	..	..	..	..	..	
14	18	20	..	18	65	84	110 0	Oscillates much, white coater good, complex in gearing, riddles good.
..	..	..	..	..	..	..	..	
14	10	20	..	16	..	93	100 0	General arrangement defective, riddle surface small, thrashed badly.
18	12	20	..	18	76	100	93 0	Admirably balanced, every part working steadily; smutter good, riddle surface very compact, with great simplicity.
..	..	..	..	..	..	..	..	
20	18	20	82	18	100	84	110 0	Everything in harmony; worked remarkably steady; slides slipped, causing the riddles to choke; in barley dressing the riddle uttered too fast for the hopper.
..	..	..	..	..	..	..	..	
4	8	14	..	14	..	88	105 0	An imperfect performance at great power.
16	10	20	..	14	45	84	110 0	Worked steadily; much gearing and passing of corn to riddles; the elevators defective and blocked up during the trial; good spring bars and shakers. The barley trial in Class VIII.
..	..	..	..	..	..	..	..	
18	8	20	..	18	55	83	112 0	A nice compact machine and well arranged for steady working; thrashed barley well.
..	..	..	..	..	..	..	..	
20	18	20	100	18	46	84	110 0	The machine was of the best manufacture and worked with great steadiness, but at a great expense of power; it makes good separations of grain and pulse.
..	..	..	..	..	..	..	..	
16	12	20	..	16	45	84	110 0	Vibrates in its work considerably, riddle surface small; a modification of Gooch's dressing machine for the finishing apparatus.
..	..	..	..	..	..	..	..	
18	8	18	..	16	..	93	100 0	The shaker is defective, too quiet.
16	12	16	..	18	73	88	105 0	Worked admirably, but we did not patronize it much, as we found it to be nearly a copy of Messrs. Clayton and Co.'s machine.
..	..	..	..	..	..	..	..	

for preparing Corn for Market, not exceeding Ten-horse Power.

20	20	20	100	..	58	100	127 10	A very perfect fixed machine.
20	20	20	82	..	100	85	150 0	

for preparing Corn for Market, not exceeding Eight-horse Power.

20	18	20	..	..	100	91	130 0	Worked admirably, all its appointments good, at a moderate price.
..	..	..	..	..	..	..	..	
20	20	20	100	..	83	97	122 10	Beautifully fitted, but all the parts too light, causing great power to work it; like the others tried, it worked with remarkable steadiness.
..	..	..	..	..	..	..	..	
20	20	20	82	..	96	100	118 10	This machine is rather lofty in height and not so compact as Hornsby's; the arrangement of working parts admirable.
..	..	..	..	..	..	..	..	
14	16	20	..	..	82	89	133 0	This is a large and powerful machine; dressing apparatus defective; the large shoe without spring-bars causes great oscillation; the elevators are high; it has a dressing machine with double blast; barley badly hummelled.
..	..	..	..	..	..	..	..	

The Tables show the relative merits of the different machines in many of the most important particulars; but some further notice of several of the machines seems to be required, and we trust that the following remarks will not be deemed invidious. We did not anticipate perfection in any machine, but we did hope to find a far greater number of them up to the mark than proved to be the case on trial. We notice in passing that only four out of fifty-five trials of the steam-power machines received our number denoting perfection in clean-thrashing; but four out of five in the horse-power machines did, which we attribute to the extra speed from being worked by steam instead of horse-power. Only eleven thrashed without injury to the grain; only five dressed perfectly; three shook the straw satisfactorily—the same three alone produced the cavings free from corn; and thirteen produced chaff without corn.

The performances of some of the machines were very nearly equal; but then we had the dynamometer to aid us, and the points selected by the managers of it to add to our own memoranda, as well as the additional points selected by the Engineering Judges; and on the summing up of the whole our decisions were based. The machines manufactured by Messrs. Clayton, Shuttleworth, and Co., and Messrs. Hornsby and Sons, were perhaps more closely matched than others; but having adopted a system, we were resolved to carry it out rather than proceed to divide the prizes amongst a numerous class of meritorious machines, of which the two named would have stood most prominent. Foster's machine came nearly upon a par with them; but there was nothing meritorious in the manufacture due to the exhibitor of it, inasmuch as it was nearly a copy of another popular machine. Messrs. Ransome and Sims' machines took a very high place, their lightness of draught being a great excellence. Messrs. Humphries showed a very useful machine; Messrs. Garrett and Sons' was large and very powerful; Messrs. Holmes and Sons' thrashed to perfection as to cleanliness, but split the corn considerably; Messrs. Barrett and Co. did fairly, but worked unsteadily; Messrs. Hart and Gibbons exhibited a good machine; Mr. Gilbert a highly useful machine; Messrs. Tuxford and Sons a highly useful machine, though it worked indifferently. We will, however, go a little more into detail: the workmanship of Hornsby and Sons' machines was superior to that of any other, good as most of them were; only one screw is now used for feeding the riddles; the barley-hummeller and smutter on one shaft across the top is a good arrangement. The shakers (Brinsmead's) of Ransomes and Co. are excellent, and are made to perform a two-fold duty; for while passing the straw over a series of revolving combs, assisted by a kind of rake to divide the straw, the corn is sent back underneath to the riddle: their new patent screw-beater to drums is highly commendable; riddles fluted and perforated. The machines of Clayton and Shuttleworth took the highest standing; it will, therefore, be desirable for us to make a remark or two upon them. Their workmanship, in the construction of their machinery, is equal to most, and nearly approaches Hornsby's; the working parts are simplified by having only one crank-shaft for driving the five-box shaker, while the effective jumping at both ends is still retained by three of the boxes working at the delivery end, and two at the receiving end; there are too many straps—nine in all; their rotary screen has several blades fixed inside for combing the corn on passing; the shogging apparatus is nicely balanced, the motion steady and even; the riddles are excellent; the barley-riddle delivered the grain faster than the dressing parts could well clear it; the latter was made of inclined wood slats, with zinc slats let in crossing them; it showed great capacity, and did not clog. Oliver Maggs and Co. exhibited a machine which deserves our notice for the introduction of a novel rotary shaker, and had the preliminary trial. Tuxford and Sons have wood bearings for their box-shakers, and cast-iron for the crank bearings; they have only

five straps, and but few riggers. Ruston and Co. have a lever motion giving a vertical jump, as well as the ordinary working, to their shakers; they have great riddle surface, a rotary screen, also a barley-hummeller, smutter, and blast, all on one shaft driven by six straps; this was withdrawn after the preliminary trial. Humphries and Co.'s little compact machine we have named; their riddles are universally known and esteemed; their shakers are boxes with iron slats; and their smut-machine is very complete; there are seven straps for every purpose. Boby and Co. have an endless web instead of shogging-board; the belt has strips of wood across it at intervals; Millington's corn-screen is attached, all driven by five straps. In Haywood's machine (which was the first tried)—both the finishing-riddles and shogging-boards are vibrated by connecting-rods and levers from the rocking-bars of the shaker, as a means of avoiding rigger-shafts and bearings; this is objectionable. Savory's table-shakers are a novelty, being of slats and cane, having a shogging-board attached beneath, and jumping with it; the riddles are also of wooden slats, with cane slips lengthways in four steps; it has a smut and cleaning-machine; the machine is worked by four straps. Fowler and McCollins' machine has a horizontal sling to hold the shogging-board, instead of guides, to keep it from shaking sideways. Garrett and Sons' has singular box-shakers, which work most efficiently; the drum and other shafts are driven by eight straps from an intermediate shaft, thus relieving the drum bearings from much friction. Gilbert's shaker is of longitudinal wood slats, with wires crossing through them; the drum-shaft projects so as to permit a small rigger and band to drive the elevators. Hart and Gibbons prolong their drum-shaft, and have three riggers upon it, which is by no means commendable; the shaker-boxes are sheet-iron slats, with wire-rod inclines for holding up and dividing lumps of straw; the riddles are of wood slats across, and beech strips lengthways; it projects endways, and the riddle of a winnower is affixed to it underneath. Cambridge has a good riddle, consisting of Venetian wood slats, with half-round cane strips running lengthways.

We were very glad to be relieved from the difficult duty of reporting on the mechanical construction and excellency of workmanship of the whole class of machines, which would have placed us in no very enviable position with the makers, and could have led to no satisfactory results. We would also here remark that our notes appended to the tabular form were taken down at the moment of adjusting the number of points.

We will now give the adjudications of the prizes as brought out by the points in the tabular statement.

In Class No. 6, for the best Portable Thrashing-Machine, worked by horse-power, not exceeding that of 6 horses, the number of points obtained were as follows:—

Messrs. Garrett and Sons	290
Messrs. Ransome and Sims	279
Messrs. Wallis and Haslam	259
Mrs. John Weighell	257

In Class No. 7, for the best Portable Thrashing-machine, not exceeding eight-horse power, for large occupations to be worked by steam power:—

Messrs. Clayton, Shuttleworth, and Co.	438
Messrs. Humphries and Co.	433
Messrs. Ransome and Sims	399
Messrs. Hornsby and Sons	399
Messrs. Garrett and Sons	358
Messrs. Barrett and Co.	343

In Class No. 8, for the best Portable Thrashing Machine that will best prepare the corn for the Finishing Dressing-Machine, not exceeding 8-hosse power :—

Messrs. Clayton, Shuttleworth, and Co.	598
Messrs. Humphries and Co.	596
Messrs. Hornsby and Sons	577
Messrs. Ransome and Sims	566

In Class No. 9, for the best Portable Combined Thrashing-Machine that will best prepare the corn for market, not exceeding 8-horse power :—

Messrs. Clayton, Shuttleworth, and Co.	Wheat ..	697	1037
	Barley ..	340	
Messrs. Hornsby and Son	Wheat ..	673	1018
	Barley ..	345	
Messrs. Ransome and Sims	Wheat ..	663	998
	Barley ..	335	
Messrs. Humphries	Wheat ..	664	966
	Barley ..	302	

In Class No. 10, for the best Fixed Combined Steam Thrashing-Machine for preparing corn for market, not exceeding 10-horse power :—

Messrs. Hornsby and Sons	699
Messrs. Clayton and Shuttleworth	698

In Class No. 11, for the best Fixed Combined Steam Thrashing-machine for preparing corn for market, not exceeding 8-horse power :—

Messrs. Clayton, Shuttleworth, and Co.	Wheat ..	666	1057
	Barley ..	391	
Messrs. Garrett and Sons	Wheat ..	647	1011
	Barley ..	364	
Messrs. Hornsby and Sons	Wheat ..	630	994
	Barley ..	364	
Messrs. Barrett, Exall, and Co.	Wheat ..	576	896
	Barley ..	320	

Consequently we awarded

Class VI.—The Prize of Ten Sovereigns to Messrs. Garrett and Sons.

Class VII.—The Prize of Fifteen Sovereigns to Messrs. Clayton, Shuttleworth, and Co.

Class VIII.—The Prize of Fifteen Sovereigns to Messrs. Clayton, Shuttleworth, and Co.

Class IX.—The Prize of Fifteen Sovereigns to Messrs. Clayton, Shuttleworth, and Co.

Class X.—The Prize of Twenty Sovereigns to Messrs. Hornsby and Sons.

Class XI.—The Prize of Ten Sovereigns to Messrs. Clayton, Shuttleworth, and Co.

Commendations.

Class VI.—We highly commended Messrs. Ransome and Sims.

Class VII.—We highly commended Messrs. Humphries, and commended Messrs. Hornsby and Sons and Messrs. Ransome and Sims.

Class VIII.—We highly commended Messrs. Humphries and Messrs. Hornsby and Sons, and commended Messrs. Ransome and Sims.

Class IX.—We highly commended Messrs. Hornsby and Sons, and commended Messrs. Ransome and Sims, Messrs. Humphries, and Messrs. Hart and Gibbons.

Class X.—We highly commended Messrs. Clayton, Shuttleworth, and Co.

Class XI.—We highly commended Messrs. Garrett and Sons and Messrs. Hornsby and Sons.

For other particulars relating to the number of points of merit obtained by other makers, we refer to the tabular account, which we believe to be correct.

John Clarke.
Geo. Shackel.
Thomas H. Barker.

Chaff Cutters, Root Cutters, Linseed Crushers, Oilcake Breakers, Dressing Machines, Cheese-Making Apparatus, &c.

The Section of Implements assigned to us for examination and trial consisted of those made use of in the preparation of food; comprising Chaff-cutters worked by hand and power; Root-cutters and Pulpers (hand and power); Corn and Linseed Crushers; Oilcake Breakers (hand and power); Winnowing and Corn-dressing Machines. These, with the exception of the two last classes, were all submitted to the dynamometer test in the shed arranged for the purpose, so that the actual power required to work them was accurately ascertained. The mode of conducting the trials for the several classes of machines will be given as we describe them in detail. We may observe, however, that in all cases "*quality of work*" was our first consideration; without that the other elements of excellence, such as power, time, construction, &c., were not admitted as valid claims for reward.

Chaff-Cutters.

The collection of Chaff-cutters was very large; there being no less than 46 exhibitors, many of whom sent specimens of various sizes, adapted for hand as well as horse or steam-power. The hand machines were examined and submitted to a preliminary trial, and the following, eight in number, selected for comparative testing. Each machine was separately attached to the dynamometer, and worked for a given time, *five minutes*; the produce (hay-chaff) was then weighed, and the power consumed noted; the number of sizes cut by the machine, the hands required to work it, the price and general construction, being the other points upon which we based our decisions.

Trials of Chaff-cutters for Hand-power.

Stand.	Article.	Name of Maker.	Weight Cut.	Power Required.	Number of Sizes.	Men Required.	Price.
			lbs.				£. s. d.
45	20	Turner	22½	·626	2	2	7 0 0
27	15	Smith and Ashby ..	21	·490	2	2	6 6 0
3	3	Richmond and Co. ..	24½	·462	3	2	7 0 0
68	3	Hill and Smith ..	23½	·510	2	2	6 0 0
6	12	Ransomes and Co. ..	25½	·457	2	2	5 5 0
94	5	Mellard	15	·462	1	2	3 15 0
69	13	Page	24½	·462	3	2	6 10 0
*39	8	*Barrett and Co. ..	19½	·402	3	2	3 10 0

* Broke during trial, withdrawn.

	Art.	St.	Manufactured by
The 1st Prize of 3*l*. was awarded to	12	6	Ransomes and Sims.
The 2nd Prize of 2*l*. to	3	3	Richmond and Chandler.
Highly Commended	13	69	— Page.

Chaff-Cutters for Horse or Steam-Power.

In this class the time of working was limited to *three minutes*—hay was used, and a three-eighths length cut by each machine tested. The machines were generally well arranged and constructed, and cut several different lengths for feeding purposes. We noticed, however, that but very few were arranged for cutting straw for litter, a point we consider of great importance, especially in covered homesteads or box-feeding, or indeed in all places where economy of material and quality of manure are matters of consideration. By dividing the litter straw between its nodes or knots in the stem, its cylindrical form exerts immediately a capillary action upon the liquid part of the secretions, absorbing them, bringing them in contact with the interior of the straw, and setting up a process of decomposition or manure-making at once. Straw thus cut will absorb more liquid, and yet form a drier bed, than when supplied to cattle in the usual form. We observed with satisfaction that very few makers retained the concave form of cutting knives; the *drawing cut* of the outward curve (or convex form) being far more efficient than the *pressure cut* of the other. At the same time we would call their attention to the advantage of arranging their knives so that the cut be continuous, and not interrupted, as is too generally seen, by the cut of one knife being completed before the succeeding one comes into action. The resistance offered through each revolution is thus unequal, and has a tendency to give the fly-wheel a lateral vibratory action, which, at high speeds, must sooner or later injure the machine. In machines for hand-power, driven at low speed, this is of no importance, as the increased momentum obtained is equal to the lessened resistance offered by the interval of the cuts.

The following were selected for trial:—

Stand.	Article.	Name of Maker.	Weight Cut.	Power Required.	Number of Sizes.	Men Required.	Price.		
			lbs.				£.	s.	d.
3	6	Richmond and Co.	$173\frac{3}{4}$	2·4	3	3	16	12	0
27	12	Smith and Ashby	$107\frac{3}{4}$	1·8	8	3	11	10	0
45	19	Turner	failed	1·8	3	3	12	11	0
50	1	Alcock	69	1·1	3	3	12	0	0
51	2	Carson	115	1·5	4	3	13	13	0
68	2	Hill and Smith ..	too coarse	1·2	..	..	12	0	0
103	1	Walker	28	·66	6	3	10	0	0
85	4	Ferrabee	too coarse	..	..	4	15	15	0
153	7	Picksley	104	1·5	6	3	11	5	0
134	1	Cornes	128	1·4	4	3	13	10	0
87	16	Garrett	161	4·	6	3	18	18	0
69	15	Page	choked	..	..	..		..	
126	68	Bentall	59	1·6	3	3	10	10	0
39	9	Barrett and Co. ..	100	1·3	6	3	15	0	0
33	23	Samuelson	135	1·6	5	3	13	0	0
6	11	Ransomes	152	2·2	3	3	24	0	0

	Art.	St.	Manufactured by
The 1st Prize of 5*l*. was awarded to	1	134	Cornes.
The 2nd Prize of 3*l*. to	23	33	Samuelson.
Highly Commended	2	51	Carson.
Commended	9	39	Barrett and Co.

Root-Cutters.

Two prizes were offered for Root-cutters, to be worked by hand or horse-power. There were 24 exhibitors, and a large collection of machines of different sizes and forms was displayed; their construction and arrangements for altering the sizes of cut being generally good. The following, adapted for "*hand-power*," were selected for trial; a given time—*two minutes*—being allotted to each; the quantity cut, the power consumed, the quality of the work, and the price being the points to which we directed our attention. In reference to the shortness of *time* of each trial we may observe that it was not in our power to afford more, owing to the large number of other trials we had to conduct within a given period.

Stand.	Article.	Name of Maker.		Weight Cut.	Power Required.	Quality of Work, 10 indicating perfection.	Price.
				lbs.			£. s. d.
6	18	Ransomes	Sheep	93½	·3	8	6 6 0
			Cattle	143½	·25	8	5 11 0
4	1	Warner	Cattle	171¾	·4	8	..
33	2	Samuelson.. ..	Sheep	101	·125	10	6 5 6
			Cattle	116	·14		
81	5	Barnard		142¾	·3	9	4 10 0
51	9	Carson		138¾	·3	9	4 10 0
153	19	Picksley		97¼	·125	8	4 10 0

	Art.	St.	Manufactured by
The Prize of 3*l.* was awarded to ..	2	33	Samuelson.
Highly Commended	19	153	Picksley.
Commended	9	51	Carson.
	5	81	Barnard.

The competition in the class of Root-cutters adapted for "horse-power" was more limited, these machines not being so portable or so extensively used as those of a smaller size. Two only were entered for competition, and were tested in the same manner as the preceding, except that the time of working was increased to *three minutes*.

Stand.	Article.	Name of Maker.		Weight Cut.	Power Required.	Quality of Work.	Price.
				lbs.			£. s. d.
6	17	Ransomes	Sheep	314½	·6	9	8 5 6
			Cattle	620	·45	9	
33	1	Samuelson..		1278	1·55	8	12 0 0

	Art.	St.	Manufactured by
The Prize of 3*l.* was awarded to the machine ..	17	6	Ransomes and Co.

Root-Pulpers.

In the class of machines for pulping or grating roots there were no less than 23 exhibitors, indicating that this description of machine is not only highly approved, but is steadily increasing in public favour. There were several different forms of construction, and various modes of effecting the work. Some cut the roots into small solid pieces, more properly mincing them, while others divided them in much thinner slices and a more efficient manner. Their construction throughout was good, and the machines were well adapted for farm work.

The following were tested; the arrangements being the same as for the power Root-cutters :—

Stand.	Article.	Name of Maker.	Weight Cut.	Power Required.	Quality of Work.	Price.
			lbs.			£. s. d.
126	7	Bentall	490	1·66	10	8 8 0
81	4	Barnard and Co. ..	$142\frac{3}{4}$	1·35	8	7 0 0
163	9	Woods	$247\frac{3}{4}$	1·	8	5 10 0
33	12	Samuelson	$349\frac{1}{2}$	1·35	8	5 10 0
113	8	Fry	$89\frac{3}{4}$	·3	8	6 10 0

	Art.	St.	Manufactured by
The Prize of 3*l.* was awarded to the machine	7	126	Bentall and Co.
Highly Commended	12	33	Samuelson.
	9	163	Woods.

Linseed or Corn Crushers.

Linseed or Corn Crushers were exhibited by 20 different makers; they were mostly modifications of the principle of two wheels of unequal diameters working in opposite directions, and capable of being set at varying distances from each other, so as to suit the degree of pressure required by the substances passed through them. These wheels are either smooth or grooved. When the machine was intended for the double purpose of crushing oats and linseed, those with grooved rollers were rejected, as in all such cases a cutting or tearing force is exerted, which is to be avoided in the oat, as, if the outer covering or chaff is disturbed, the inner portion or meal is sure to be wasted. This is of not so much importance in regard to linseed, as therein it is desirable to break up the outer covering as much as possible in order that the inner cells may be ruptured more completely and more regularly.

The method we adopted for testing these machines differed somewhat from that for the preceding classes. A *sample quality* of *crushed* linseed and *crushed* oats was determined upon, and a given quantity of each (20 lbs.) weighed out for each machine; the exhibitor arranging and setting the machine, so as to work up to the sample quality. The time and power required were then noted, the quantity and quality of work to be performed being already fixed.

The following were then tested :—

Stand.	Article.	Name of Maker.		Time.	Power Required.	Quality of Work.	Price.
				Min. Sec.			£. s. d.
11	1	Stanley ..	Linseed	1 10	2·2	20	11 0 0
			Oats ..	1 55	3·		
33	3	Samuelson	Linseed	1 9	2·35	20	9 0 0
			Oats ..	1 32	2·6		
45	1	Turner ..	Linseed	1 30	*	..	13 0 0
			Oats ..	1 33	*		
6	14	Ransome ..	Linseed	1 14	1·7	20	10 0 0
			Oats ..	1 28	2·6		
163	2	Woods ..	Linseed	1 5	2·4	20	11 11 0
			Oats ..	1 20	2·7		

* Disqualified for altering gauge while being tried.

	Art.	St.	Manufactured by
The Prize of 5*l.* was awarded to the machine	14	6	Ransomes and Sims.
Highly Commended	3	33	Samuelson and Co.

The machines were generally well constructed, very efficient in their work, and well calculated for the purposes for which they are intended. The advantage of such machines to the farmer for crushing oats or linseed for feeding purposes, both as regards his stables and his cattle-sheds, cannot be too highly estimated.

Oilcake Breakers.

Two prizes were offered for Oilcake Breakers: one for machines to be used by hand-labour for common English cake, the other for machines suited for larger cakes, such as the American, and adapted for horse or steam-power. The "hand-power" machines were tested first. These were each worked for a given time (*three minutes*), and the weight of cake passed through the machine, the quality of the work done, and the power consumed, duly noted; with the following results,—

Stand.	Article.	Name of Maker.	Weight Cut.	Power Required.	Quality of Work.	Price.		
			lbs.			£.	s.	d.
23	3	Maynard	86½	1·6	8	7	5	0
45	22	Turner	30¾	·9	8	3	10	0
126	3	Bentall	35¼	·5	9	3	13	6
27	16	Smith and Ashby ..	128¾	·8	8	3	15	0
87	20	Garrett	56½	1·0	8	4	5	0
94	10	Mellard	24½	·8	9	4	10	0
75	15	Nicholson	29½	·4	10	3	10	0
33	45	Samuelson	55	·9	8	3	15	0
38	5	Goulding	36½	·5	5	3	6	0
6	16	Ransome	18	·4	8	4	10	6
14	4	Fisher	34¼	·6	6	3	5	0

	Art.	St.	Manufactured by
The Prize of 3*l.* was awarded to the machine	15	75	Nicholson.
Highly Commended	3	126	Bentall.
Commended	16	27	Smith and Ashby.

The machines, of which a great number were exhibited by 27 different makers, were in general well constructed, and did good work. In some of them the absence of a screen to separate the small pieces and dust rendered the sample inferior; this point should be attended to, especially when the cake is intended for sheep-feeding in the field.

Unfortunately very little thick cake could be had for the trial of the larger machines, consequently those adapted for such cake were worked at a comparative disadvantage, as the thin English cake was mostly used. The time in these trials was limited to *two minutes* breaking for sheep. The other points of observation were the same as the preceding.

Stand.	Article.	Name of Maker.	Weight Cut.	Power Required.	Quality of Work.	Price.		
			lbs.			£.	s.	d.
87	19	Garrett	24	·15	8	11	0	0
6	15	Ransome	..	..	..	11	10	0
23	3	Maynard	157½	·6	6	12	10	0
47	17	Hornsby	101	·5	9	10	0	0
39	10	Barrett	117	1·0	9	13	13	0
14	5	Fisher	152	·7	6	5	0	0
75	18	Nicholson	93	·25	8	5	10	0
126	1	Bentall	165½	·7	10	5	5	0

	Art.	St.	Manufactured by
The Prize of 5*l*. was awarded to the machine ..	1	126	Bentall.
Highly Commended	18	75	Nicholson.
	17	47	Hornsby.
Commended	5	14	Fisher.

Winnowing Machines.

The classes of Winnowing and Corn-dressing Machines were worked in the usual way by manual labour; a given time (*three minutes*) was allotted to each, and the weight of grain winnowed or dressed, and the quality of the work, noted. A large heap of corn (wheat), as it came from the drum of the threshing machines, mixed with the sweepings of the threshing floor, so as to form as regular and as rough a mixture as possible, was prepared, from which each of the following machines was supplied :—

Stand.	Article.	Name of Maker.	Weight Winnowed.	Quality of Work.	Price.
			lbs.		£. s. d.
67	1	Eaton	424	2	8 10 0
75	2	Nicholson	552	8	12 12 0
47	11	Hornsby	761	10	13 10 0
97	1	Smith	583	4	13 13 0
87	13	Garrett	321	9	12 10 0
164	1	Coultas	287	4	11 11 0
6	9	Ransome	withdrawn.		
37	1	Boby	ditto.		
138	1	Davis	147	2	8 0 0

	Art.	St.	Manufactured by
The Prize of 5*l*. was awarded to the machine ..	11	47	Hornsby.
Highly Commended	13	87	Garrett.
Commended	2	75	Nicholson.

The operation of separating the chaff and cavings from the threshed corn being effected by the combined threshing machines now so generally in use, the time for offering prizes for these machines appears to us to be quite gone by. The mode of construction in all the machines submitted to trial exhibited no improvement upon what has appeared in former years, and most of the leading makers have ceased to consider them as worth any special attention.

Corn-Dressing Machines.

The mode of testing these Machines was the same as with the preceding class. A large heap of trial corn was prepared, taken as it came from the Winnowing Machines of the preceding trial, without screening, but merely mixed up to ensure regularity. The class was largely represented, no less than 28 makers being exhibitors. The following were tested :—

Stand.	Article.	Name of Maker.	Weight of Best Corn.	Weight of Seconds.	Quality of Work.	Price.
			lbs.			£. s. d.
38	49	Goulding	336	24¼	3	12 10 0
75	3	Nicholson	642	66½	3	10 10 0
7	18	Cartwright		fan broke in trial.		
40	9	Cambridge	436½	39½	7	10 10 0
164	2	Coultas	377	12	8	7 0 0
121	4	Wallis and Co.	175	10	3	10 10 0
47	12	Hornsby	736	25½	7	10 10 0
87	15	Garrett	242	17½	10	6 5 0
123	3	Winsor	437	55½	3	7 0 0
97	2	Smith	296	21	6	11 11 0
67	2	Eaton	319	14	3	7 7 0
138	3	Davies	292	38½	3	6 0 0
134	16	Cornes	389	103	6	8 0 0
91	4	Howe	450	57½	6	12 11 0
8	3	Sawney	400½	36	7	10 0 0
37	2	Boby	413	16	9	15 0 0

	Art.	St.	Manufactured by
The Prize of 5*l.* was awarded to the machine ..	15	87	Garrett.
Highly Commended	2	37	Boby.
Commended	2	164	Coultas.

These machines were generally well got up and arranged. The only remark we would make is, that in some of them *quantity* rather than *quality* of work seemed to be the point aimed at.

Screens for Corn and Seeds.

These Machines are not much used on a farm, and but few were entered for trial. The mode we adopted of testing their powers was to give a certain weight (56 lbs.) of riddled corn to each, and to note the time required to pass it through the screen, and the quality of the work when done. The following were tried :—

Stand.	Article.	Name of Maker.	Time.	Comp. Power.	Quality of Work.	Price.
			Min. Sec.			£. s. d.
66	159	Chivas	1 45	57	6	10 10 0
81	15	Barnard and Co. ..	1 23	77	7	10 10 0
96	9	Reeves	40	43	6	9 10 0
75	6	Nicholson	58	52	7	10 10 0
37	4	Boby	1 25	36	10	9 0 0

	Art.	St.	Manufactured by
The Prize of 3*l.* was awarded to the machine ..	4	37	Boby.

In the class of Screens for Seeds there were no entries.

Cheese-Making Apparatus.

At the request of the Senior Steward of Implements we subsequently examined the apparatus entered for the prize offered in this class. There were 4 exhibitors.

Art.	St.		Prize. £. s. d.
2	144	Griffiths	25 0 0
10	96	Reeves	22 0 0
17	134	Cornes	2 15 0
44	134	Cawley	2 10 0

We awarded the Prize of 3*l.* to article 2, stand 144, exhibited by Griffiths and Co.; the apparatus invented and patented by R. Keevil, of Lacock, Wilts, and manufactured by the exhibitor. This has already received a prize from the Society, and its arrangements and improvements been duly reported upon.

We at the same time awarded a Silver Medal to the apparatus exhibited by Reeves (article 10, stand 96), which, although a close imitation of Keevil's patent, contained an improvement on it in the shape of an arrangement for regulating the temperature of the milk and curd.

Paring Plough.

We also awarded a Silver Medal to a new Paring Plough, article 1, stand 124, Woofe. It was an extremely well-made and efficient implement, and in trials both on the light land and the heavy land at Blacon, it performed quite to our satisfaction; paring slices of the surface from 12 to 18 in. broad, by 1 in. thick, and turning them well over. It has an arrangement for cutting these longitudinally in 2 ft. lengths to facilitate burning, and also for clearing away the soil that may accumulate on the turn-furrow by means of a slide movement. It is made entirely of iron. Price 6*l.* 6*s.* complete.

Joseph Druce, Eynsham, Oxon.
John Hicken, Bourton-on-Dunsmore, Rugby.
John Wilson, Edinburgh.

Mills, Churns, and Miscellaneous Articles.

The portion of the Prize List allotted to us comprised "Bone Mills," "Bonedust Mills," "Grinding Mills" (steel or stone), "Churns," "Cheese-Presses," and the Miscellaneous Department. The statistics of the Society will show the vast increase in the number of implements that were exhibited at the Chester Meeting, and we are enabled to report favourably of the continued improvements made from year to year. With regard to the "Miscellaneous Department," it is a matter of some difficulty to award the medals, there being under this head many implements varying so r ich in the purposes for which they are intended, that in our opinion it would be better to class them under different heads, so that the Judges might come to a more satisfactory conclusion as to the merits of each. We have, however, endeavoured to exercise our best judgment in the matter.

Churns.

Prizes.	Stand.	Art.	Exhibitors.	Cream.	Butter.	Time in making.	Price.	Remarks.
				pints.	oz.	min.	£. s.	
£3	9	18	Burgess and Key.	8	25	22	2 2	Quality and colour very good.
Highly commended.	29	2	Ferryman	5	$16\frac{1}{2}$	31	1 10	Quality and colour good.

Bone Mills and Bonedust Mills came next under our observation. In this class we were most anxious to arrive at a sound conclusion, and, assisted by Mr. Amos, we tested these mills both as to the goodness of their manufacture and the efficiency of their work. There were five competitors.

Bone-Mills.

Prize.	Stand.	Article.	Exhibitor.	Bones.	Time.	Quantity produced.	Remarks.
				cwt.	m. s.	cwt. qr. lb.	
£10	31	37	Crosskill	3	3 35	3 0 3	The increase of weight must have been produced in shovelling up the bones.

The price of this mill is 185*l.*

Bonedust Mills.

For this class there were three competitors.

Prize.	Stand.	Article.	Exhibitor.	Bones.	Time.	Quantity produced.	Remarks.
				cwt. lbs.	m. s.		
£5	31	39	Crosskill	1 24	1 47	23 lbs. of $\frac{1}{2}$-inch 1 cwt. 8 lbs. bone-dust.	Weight of sack, about 8 lbs., to deduct.

The price of this mill is 75*l.*

Grinding Mills.

We now come to the Stone Mills. Thirteen contended for the premium of 10*l.*, which was awarded to

Article.	Stand.	Exhibitor.	Meal produced.	Time.
18	87	Garrett & Son	37 lbs.	5 min.

Price, fitted with 42-inch stones, 59*l.*

Cheese Presses.

In this class we had ten competitors, from which we selected two implements as superior to the rest, namely, that of Mr. Carson, to whom we awarded a prize, and that of Mr. Silcock, as being worthy of commendation.

	Article.	Stand.	Exhibitors.	Price.
Premium £3	13	51	Carson	£2 15*s.*
Commended	4	173	Silcock	3 0

Miscellaneous Articles.

We awarded a Silver Medal to a *Patent Chronometrical Thermometer.* Art. 4, Stand 9; invented by Mr. H. Guemblott, and exhibited by Messrs. Burgess and Key.—This instrument is extremely clever and invaluable for horticultural purposes, hospitals, &c. The great novelty consists in metallic tubes being used instead of mercury. These tubes expand and contract as the temperature varies. It is shown at a glance what the temperature of the forcing-house or conservatory has been during any portion of the day or previous night, the exact moment at which a change took place, and how long it continued. Price 7*l.* 10*s.*, including an 8-day clock.

We also awarded—

A Silver Medal to a *Draining-Pipe and Tile-Machine.* Art. 20, Stand 69; exhibited by Page and Co.—The improvement in this machine consists in its being capable of making pipes from $1\frac{1}{4}$ inch to 13 inches bore. Its strength, durability, and first-rate workmanship particularly attracted our notice.

A Silver Medal to *Rowley's Blast-Drill.* Art. 4, Stand 119; exhibited by Priest and Woolnough. Price 18*l.*—This implement, whilst it effectually destroys the fly on the turnip-crop, at the same time applies a top-dressing of lime, soot, or other compost; and we are of opinion that it might likewise be successfully used for destroying the black caterpillar, which commits such extensive ravages on the plant.

A Silver Medal to a *Whisk.* Art. 4, Stand 120; exhibited by Turner. Price 1*l.* 10*s.*.—This newly-invented and clever machine for mixing liquids, &c., is also a most valuable acquisition to the cook's department, it being capable of beating up any quantity of whites of eggs in the short space of 3 minutes; it will also make any small quantity of butter.

We highly commended the following articles:—

Iron Sheep-Hurdles, Art. 126, Stand 68, exhibited by Hill and Smith, which are well worthy the farmer's attention, being very strong and reasonable in price, 4*s.* 2*d.* each. Their assortment of iron gates and fencing all good.

A *Patent adjusting Corn-Screen.* Art. 6, Stand 37; exhibited by Boby. The implements at this stand were particularly good. Article No. 6 attracted our especial attention from its simple and ingenious contrivance for adjusting the screen so as to make it fine or coarse. Price 12*l.*

A $1\frac{1}{2}$*-inch Patent Spherical Plummer Block and Bearings.* Art. 14, Stand 121; exhibited by Wallis and Haslam.—In whatever way you place the bearing it instantly adjusts itself to the right angle of the spindle, and thereby prevents any cross-tie or wear, and in quick motions will be found invaluable, as they do not heat or fret in use. Price 1*l.* 12*s.* 6*d.*

A 4*-inch Copper Liquid Manure and Force-Pump, with Patent Valves.* Art. 45, Stand 26; exhibited by Perriaux and Co.—Very useful, and adapted to all farms. The general assortment of this stand very good. Price 9*l.* 8*s.*

A *Portable Clover-Machine.* Art. 4, Stand 41; exhibited by E. and T. Humphries.—A most useful implement, worthy of the consideration of all clover and trefoil growers. Will thresh from 10 to 15 cwt. of seed per day. Price 35*l.*

Weighing-Machines and other Useful Implements, suited to every Farm. Stand 58; exhibited by Mapplebeck and Lowe.—In this stand the selection of draining-tools, spades, shovels, cast-steel digging-forks, &c. &c., were particularly good. Price of Art. 44, 5*l.* 5*s.*; Art. 46, 2*l.* 5*s.*

An *Iron Cow-Crib.* Art. 26, Stand 63; exhibited by Underhill.—A useful and economical article. Price 1*l.* 10*s.*

A *Patent Kneading Apparatus.* Art. 186, Stand 66; exhibited by Chivas. —Remarkable for its great simplicity of principle and the expedition with which it kneads the dough. Price 5*l.* 5*s.*

A splendid assortment of *stable fittings,* elegantly designed and of first-rate workmanship. Stand 79; exhibited by Cottam and Cottam.

General assortment of *wire-fencing, wrought-iron gates and hurdles.* Stand 95; exhibited by Peake. All very good.

A *Patent Hand-Drill for Corn or Seeds.* Art. 8, Stand 96; exhibited by Reeves.—Well calculated for small occupations and market gardeners. Price 3*l.* 10s.

Various machines and tools for straining and knotting wire-fencing; Kannan's Collar Vice; an apparatus for blasting roots and stumps of trees. Stand 111; exhibited by Kannan and Son.—The whole of these implements are very useful, and well worthy the attention of landed proprietors.

Of the *general assortment* of Stand 147, exhibited by Hermilowicz and Co., we are enabled to speak favourably.

Fisher King.
Charles Wedd Willsher.

Specification of Steam-Engine and Boiler, by Barrett, Exall, and Andrews, for which they received the first Prize.—(*See* p. 348.)

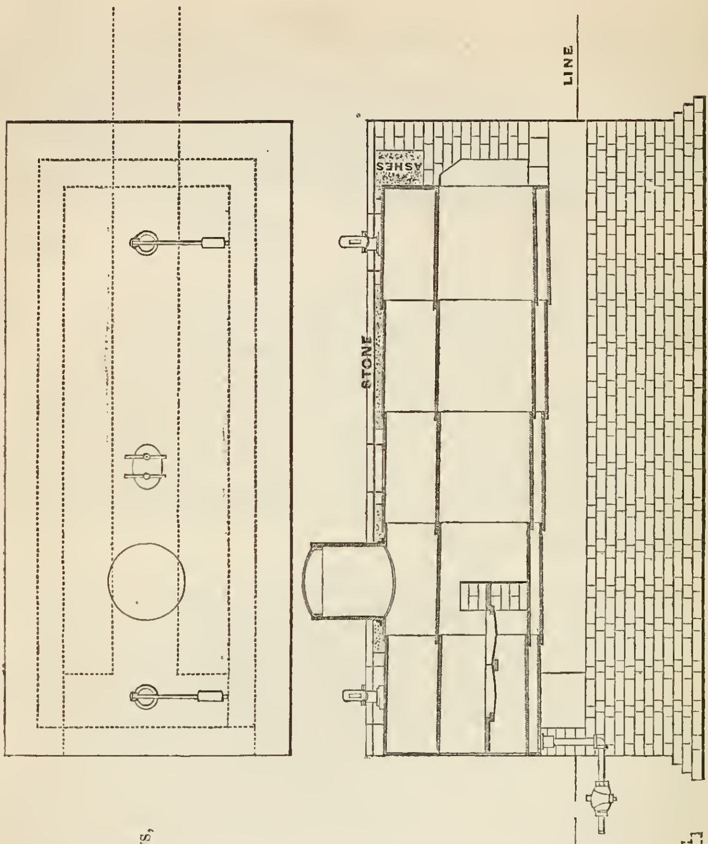
A 10-horse power Horizontal Fixed Steam-Engine; invented, improved, and manufactured by the exhibitors. It is fitted with complete expansion apparatus. The boiler is 16 feet long by 4 feet 6 inches diameter, with tube 2 feet 6 inches diameter, made of the best Staffordshire iron, $\frac{3}{8}$ inch thick, and riveted together by $\frac{5}{8}$ inch rivets 2 inches apart from centre to centre. Is supplied with a safety-valve and Salter's spring-balance, glass water-gauge, &c., and fire-bars complete. Price 230*l.*, exclusive of carriage, brickwork, or masonry, but inclusive of fixing.

Specification of Steam-Engine and Boiler, by Messrs. Hornsby and Son, for which the second Prize was awarded.—(*See* p. 349.)

An Eight-Horse-power Horizontal Fixture Steam-Engine: invented, improved, and manufactured by the exhibitors. The cylinder is $8\frac{3}{4}$ inch diameter and 14 inch stroke; the crank-shaft, which is of best hammered scrap-iron, is, at the journals, $2\frac{7}{8}$ inch; other parts $3\frac{1}{4}$ inch. The fly-wheel is 5 feet diameter, weighs $11\frac{1}{4}$ cwt., and makes 125 to 135 revolutions per minute; the boiler is 12 feet long, and 4 feet 6 inches diameter, with tube 2 feet 6 inches diameter, in which the fire is placed. Quality of plates: best B B H Butterley or Staffordshire iron; thickness of ditto, $\frac{1}{2}$ inch $\frac{3}{8}$ inch: distance between the rivets, 2 inch and $2\frac{1}{2}$ inch: diameter of ditto, 9-16ths and $\frac{3}{4}$ inch. It is fitted with glass water-gauge, two gauge-cocks, two safety-valves with weighted levers, furnace door with frame, fire-bars, dead-plates, perforated-iron bridge, and blow-off cock, &c. Price 205*l.*

Specification of Biddell and Balk's Patent Boiler of Ten-Horse Power, by Ransome and Sims, to which the Prize was awarded.—(*See* p. 350.)

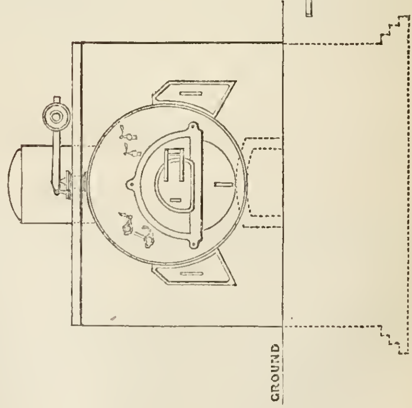
A Patent Steam Boiler, of Ten-Horse Power; invented by Biddell and Balk, of Ipswich, and manufactured by the exhibitors. In this boiler the fire-box, with the tubes and back tube-plate (as one piece), are bolted to the shell at the front and back, so as to admit of being readily drawn out for the purpose of examination, cleaning, or repairs. The surfaces of contact are accurately turned, in order to facilitate the making of the joints steam-tight. This boiler requires no setting, but rests on two cast-iron chairs, and is ready for use as soon as it is placed tolerably level in its appointed locality. It is furnished with furnace-front, damper, fire-bars, bridge and bearers, stop and safety-valves, glass water-gauge, gauge-cocks, and blow-off cock. Price, 155*l.*; wrought-iron chimney, 25 ft. high, 19*l.* extra; lagging with wood, 16*l.* extra.

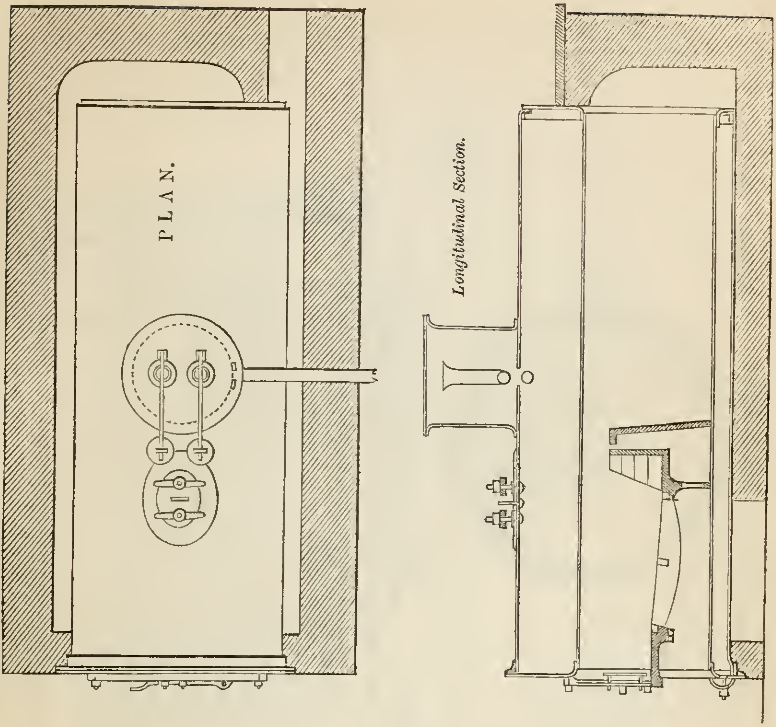


BOILER TO 10-HORSE POWER
FIXED ENGINE.

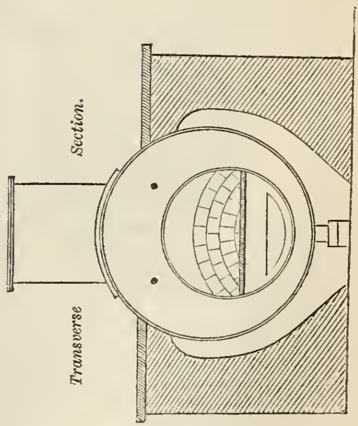
Messrs. Barrett, Exall, and Andrews,
which received the First Prize.

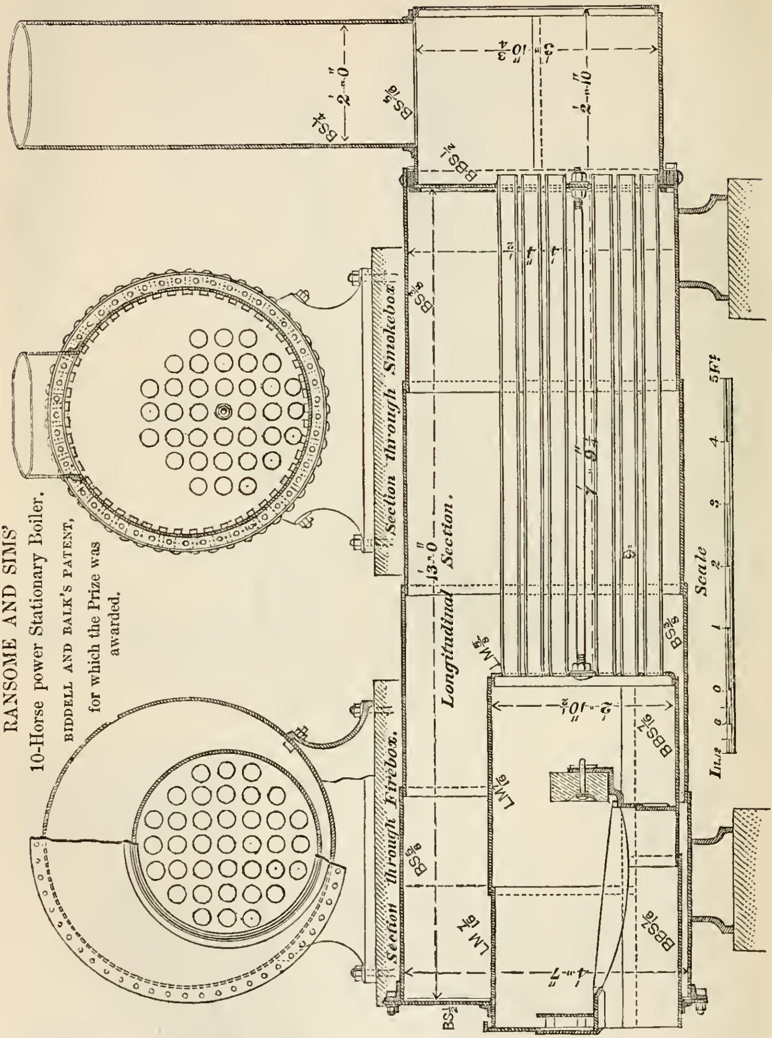
Scale, $\frac{3}{16}$ths of an Inch to a Foot.





BOILER to be supplied by Messrs. Hornsby and Son, with their 8-horse fixed steam-engine, for which the Second Prize was awarded.

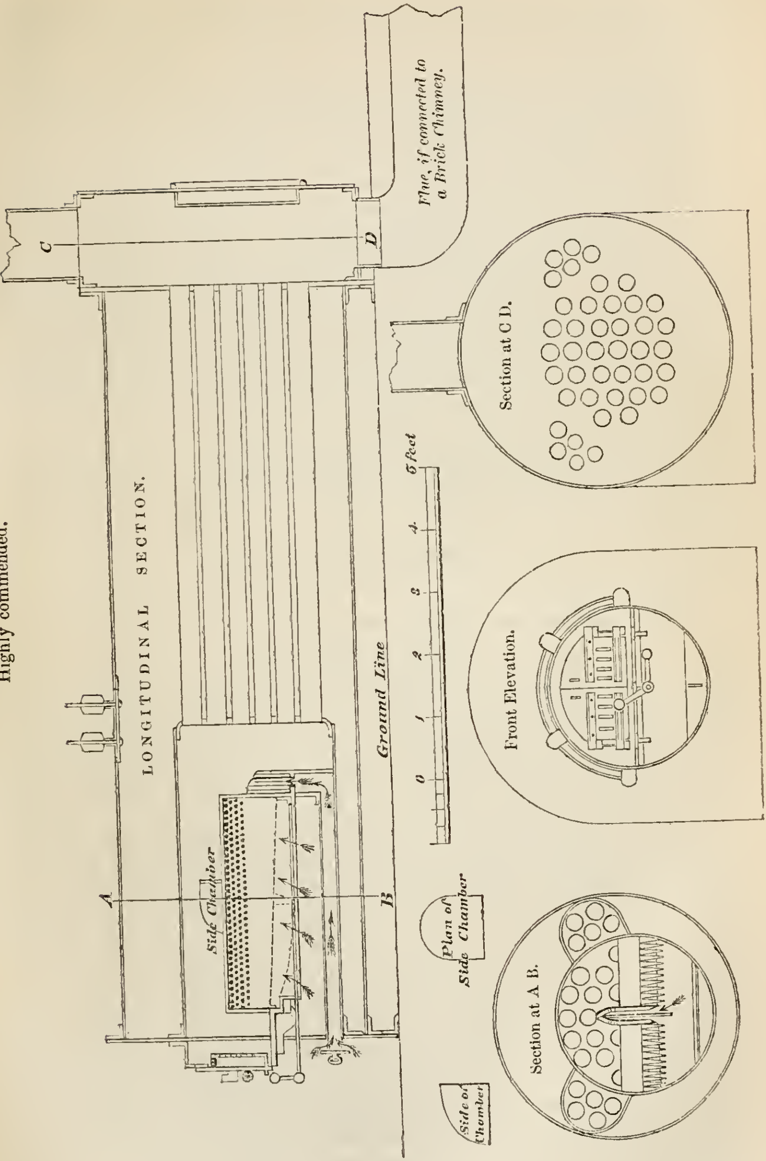




RANSOME AND SIMS'
10-Horse power Stationary Boiler.
BIDDELL AND BALK'S PATENT,
for which the Prize was
awarded.

GEORGE HOWE'S 10 HORSE-POWER BOILER FOR FIXED ENGINES.

Highly commended.



Specification of George Howe's Ten-Horse Power Boiler for Fixed Steam-Engines, highly commended by the Judges.—(*See* p. 351).

The shell of the boiler is 3 ft. $10\frac{1}{2}$ in. diameter; 12 ft. long from the front to back tube-plate.

The fire-box is 5 ft. long, and 2 ft. 6 in. diameter. The smoke-box is 1ft. 6 in. long, and the diameter of the boiler: it is fitted with a double-cased door for cleaning out the tubes.

There are 32 tubes 3 in. diameter inside, 7 ft. long from back of the fire-box to the smoke-box; and 10 tubes 3 in. diameter inside, 9 ft. 6 in. long from the side chambers on each side of the fire-box to the smoke-box.

The fire-bars are 3 ft. 6 in. long by 2 ft. 4 in. The fireplace is divided into two compartments by a narrow cast-iron box open at the bottom, perforated with a number of $\frac{3}{8}$ holes on each side, with a partition in the centre, and a valve along the opening at the bottom, so that air can be allowed to pass into either side, and through the $\frac{3}{8}$ holes, mixing with the gases of the fuel, causing their combustion, and preventing smoke. The bridge at the back is hollow, and perforated with $\frac{3}{8}$ holes, and connected with an air channel along the bottom of the fire-box to the front of the boiler, where there is a valve for regulating the supply of air for the same purpose.

It is intended that the fresh fuel should be supplied alternately on each side of the air-box forming the partition in the fireplace.

The fittings consist of one 3 in. enclosed safety-valve, two water-gauges, one patent steam-gauge, and a blow-off cock.

XV.—*Report on the Exhibition of Live Stock at Chester.* By Robert Smith.

Whether we regard the interest which attaches to it as to any good collection of live animals, or the purposes served by it in bringing together specimens of the best stock required on a farm, we may safely assert that the Society's Exhibition at Chester has been unequalled by that of any former year.

The successful efforts of the earliest improvers had already shown that great improvement in the breeding of stock was possible, and this—confirmed by the practice and experience of many eminent breeders of more modern times—has just received its most striking illustration. Certainly we have had much to admire in the Chester Exhibition: the animals in general were good of their kind, and it clearly appeared that a greater uniformity of opinion as to the points of excellence in the animal frame is becoming established among breeders. To this remodelled style in our animals we have to add the influences of improved culture, and of a great extension in the growth of root crops enabling the maintenance of larger herds of cattle, before we can fully understand the enormous progress made in all sorts of agricultural produce, but especially in those breeds of live stock which are the produce of the varied soils and climates of our several

English counties. That it is all needed is apparent from the rapid increase in our population, the growing wants of the people, and the increasing *foreign* trade in English animals. The consequently increased demand upon the land shows the national importance of closely observing and applying the best principles of agriculture, so that not only an increased number of the best animals may be perpetuated, but an additional weight of animal food supplied.

The subject of this Report, 'the exhibition of live stock, the produce of a nation,' is, indeed, in this view of it, one of very great moment. Twenty such exhibitions have now taken place, *namely*, at Oxford, Cambridge, Liverpool, Derby, Bristol, Southampton, Shrewsbury, Newcastle-upon-Tyne, Northampton, York, Norwich, Exeter, Windsor, Lewes, Gloucester, Lincoln, Carlisle, Chelmsford, Salisbury, Chester—every one of them contributing, and the last one most of all, to our increasing annual agricultural produce, by enabling, as I have said, both the observation and the application of sound agricultural principles.

Now that the Society has held its twentieth anniversary, it may be well to continue the good work commenced by Mr. Jonas (as senior steward) in 1852. In his Report of the Lewes meeting he gives a tabular statement of the Society's exhibitions up to that year. This Report, extending as it does over the first fourteen years of the Society's progress, is exceedingly interesting. It is contained in vol. xiii. p. 398. Before, however, giving a continuation of these official figures, I must cordially thank my friend Mr. Jonas for the zeal shown by him for the Society's interest at the Salisbury meeting, where the whole responsibility of the stewardship devolved upon him. In addition to discharging thus the duties of three men there, he wrote a Report of the Exhibition, but this reached the Journal Committee too late for insertion in the subsequent Journal. This document has been handed over to me; and although its immediate interest has now passed away, yet I am bound in justice to my colleague to quote his statement of the difficulties in which he was placed on that occasion.

"In the absence from the Show of Sir Stafford Northcote, the senior steward of the yard, and the unavoidable absence of Mr. Robert Smith, the other steward, the duty of drawing up a Report has devolved upon me. I think that, under the extraordinary circumstances in which I was thus placed, I am justified in craving the indulgence of the Council for this imperfect Report. Notwithstanding the weight of undivided responsibility, to say nothing of the amount of labour, thus entailed upon me, I at once applied myself to the discharge of the duties of the office in a manner, if possible, to prevent complaints, in which I trust I have succeeded; but I am bound to say that the successful issue of our meeting was owing to the extraordinary order, method, and arrangement adopted by our honorary Director, Mr. Brandreth Gibbs: his system is so perfect, that no mistake can well occur. I am proud in

bearing willing testimony to his untiring zeal and energy in conducting our annual meetings, and his officials are as exact and indefatigable as their employer." *

Mr. Jonas has well expressed the feelings of the Chester stewards upon the question of "admission orders." Names of persons quite unconnected with the stock are too often sent up to the Director, and not a few try to practise some deception upon the authorities in order to procure admittance before the Judges have made their award. This subject engrossed so much attention at Chester, that I adopt Mr. Jonas's words, as contained in his Salisbury Report:—

"I am anxious to draw the attention of the Council to the constant vigilance required to prevent improper persons from entering the Show Yard, and I must say that I could not have believed, until I saw it, the constant and varied attempts made by exhibitors themselves or their agents to get into the yard before the Judges have made their awards: I trust the perusal of these remarks will induce persons to desist from such practices in future."

Before entering upon the merits of our breeds of live stock, I will place upon record the tabular documents I have mentioned, giving the numbers of the principal stock shown since the Lewes Meeting, and adding to them in Table X. Mr. Jonas's "Summary of Live Stock exhibited" up to that time.

TABLE I.—SHORT HORNS.

Year.	Place of Meeting.	Bulls exceeding 2, and not exceeding 4 years old.	Bulls exceeding 1, and not exceeding 2 years old.	Bull Calves.	Cows in Milk or in Calf.	Heifers in Milk or in Calf.	Yearling Heifers.	Total.
1853	Gloucester ..	18	11	..	23	8	13	73
1854	Lincoln	19	23	12	27	8	20	109
1855	Carlisle	18	18	12	10	14	26	98
1856	Chelmsford ..	18	14	10	9	7	17	75
1857	Salisbury	21	23	14	16	10	22	106
1858	Chester	28	20	20	12	11	33	124

TABLE II.—HEREFORDS.

1853	Gloucester ..	9	8	..	12	6	7	42
1854	Lincoln	3	6	1	2	2	5	19
1855	Carlisle	10	3	6	5	2	6	32
1856	Chelmsford ..	4	9	4	7	2	14	40
1857	Salisbury	5	8	5	11	9	19	57
1858	Chester	9	15	14	9	8	14	69

* Mr. Brandreth Gibbs has performed these onerous duties during the last fifteen years, and also assisted his brother, Mr. Brandreth (the then Honorary Director), at the first five shows.

TABLE III.—DEVONS.

Year.	Place of Meeting.	Bulls exceeding 2, and not exceeding 4 years old.	Bulls exceeding 1, and not exceeding 2 years old.	Bull Calves.	Cows in Milk or in Calf.	Heifers in Milk or in Calf.	Yearling Heifers.	Total.
1853	Gloucester ..	7	9	..	14	11	12	53
1854	Lincoln	7	5	2	10	3	11	38
1855	Carlisle	4	2	1	6	4	6	23
1856	Chelmsford ..	9	6	4	11	8	13	51
1857	Salisbury.. ..	10	11	6	15	13	14	69
1858	Chester	5	5	8	9	3	7	37

TABLE IV.—OTHER ESTABLISHED BREEDS.

1853	Gloucester ..	3	1	..	6	1	4	15
1854	Lincoln	..	4	..	10	1	2	17
1855	Carlisle	..	..	..	..	..	..	..
1856	Chelmsford ..	6	2	..	6	6	4	24
1857	Salisbury.. ..	..	..	..	5	..	2	7
1858	Chester	5	4	..	6	4	3	22

TABLE V.—HORSES.

Year.	Place of Meeting.	Agricultural Stallions of any Age.	Agricultural Stallions, 2 years old.	Agricultural Stallions, 1 year old.	Thoroughbred Stallions.	Clydesdale Stallions.	Hackney Stallions.	Dray Stallions.	Agricultural Mares and Foals.	Agricultural Fillies.	Hunter Mares.	Hackney Mares.	Hunting Fillies, Colts, or Geldings.	Cart, Harness, or Hackney Geldings.	Agricultural Fillies or Geldings.	Total. (*a*)
1853	Gloucester .	31	21	..	..	..	..	..	11	6	..	..	..	..	..	98
1854	Lincoln . .	25	8	13	..	..	..	..	14	16	..	..	9	..	..	106
1855	Carlisle . .	21	14	18	13	12	..	..	14	16	13	..	6	9	..	174
1856	Chelmsford .	46	29	10	..	8	10	7	21	17	5	11	14	5	..	196
1857	Salisbury .	37	23	..	15	..	12	8	26	15	9	4	..	..	..	151
1858	Chester . .	33	19	..	15	..	16	14	16	12	15	5	14	..	8	221

(*a*) Including in most of the meetings entries, not here particularised, of pony, roadster, coaching, and hunting stallions, also harness and pony mares and foals; and at Carlisle several entries of Clydesdale mares and foals.

Table VI.—Leicester Sheep.

Year.	Place of Meeting.	Shearling Rams.	Rams of any other Age.	Shearling Ewes.	Total.
1853	Gloucester	28	31	20	79
1854	Lincoln	54	35	60	149
1855	Carlisle	65	39	70	174
1856	Chelmsford	34	23	15	72
1857	Salisbury	30	22	50	102
1858	Chester	38	23	45	106

Table VII.—South Down or other Short-woolled Sheep.

Year.	Place of Meeting.	Shearling Rams.	Rams of any other Age.	Shearling Ewes.	Total.
1853	Gloucester	65	20	50	135
1854	Lincoln	36	19	60	115
1855	Carlisle	36	18	25	79
1856	Chelmsford	52	39	70	161
1857	Salisbury	116	74	230	420
1858	Chester	84	43	175	302

Table VIII.—Long-woolled Sheep (not Leicesters).

Year.	Place of Meeting.	Shearling Rams.	Rams of any other Age.	Shearling Ewes.	Total.
1853	Gloucester	45	17	80	142
1854	Lincoln	56	16	120	192
1855	Carlisle	36	18	45	99
1856	Chelmsford	21	19	60	100
1857	Salisbury	45	24	75	144
1858	Chester	44	17	75	136

Table IX.—Pigs.

Year.	Place of Meeting.	Boars of a large Breed.	Boars of a small Breed.	Sows of a large Breed.	Sows of a small Breed.	Breeding Sow Pigs of a large Breed.	Breeding Sow Pigs of a small Breed.	Total.
1853	Gloucester ..	15	44	19	54	12	30	174
1854	Lincoln	24	35	19	49	6	6	139
1855	Carlisle	10	20	14	27	15	24	110
1856	Chelmsford ..	17	27	13	29	15	36	137
1857	Salisbury	24	49	33	59	24	36	225
1858	Chester	19	26	35	40	15	33	168

TABLE X.—SUMMARY of LIVE STOCK exhibited since the formation of the SOCIETY.

Description of Stock.	Oxford.	Cambridge.	Liverpool.	Bristol.	Derby.	Southampton.	Shrewsbury.	Newcastle.	Northampton.	York.	Norwich.	Exeter.	Windsor.	Lewes.	Gloucester.	Lincoln.	Carlisle.	Chelmsford.	Salisbury.	Chester.
	1839	1840	1841	1842	1843	1844	1845	1846	1847	1848	1849	1850	1851	1852	1853	1854	1855	1856	1857	1858
Short Horns	27	47	67	52	79	66	69	115	92	110	95	68	176	64	73	109	98	75	106	124
Herefords	24	7	27	38	23	33	72	23	35	30	28	25	41	29	42	19	32	40	57	69
Devons	15	25	9	46	12	23	11	15	28	30	48	125	73	38	53	38	23	51	69	37
Cattle of any breed	23	17	13	41	17	34	11	27	10	8	35	10	15	17	15	17	..	24	7	22
Horses	22	35	19	39	34	38	32	55	51	144	88	59	119	87	98	106	174	196	151	221
Leicester Sheep ..	50	51	96	40	148	67	110	174	133	199	163	135	196	90	79	149	174	72	102	106
South Down or other Short - woolled Sheep	70	127	64	73	58	115	90	76	115	62	152	108	212	158	135	115	79	161	276	164
Long-woolled Sheep, not Leicesters ..	41	48	74	40	26	52	31	22	41	58	49	42	49	27	142	192	99	100	144	136
Pigs	24	22	18	68	82	86	50	107	50	158	111	147	223	186	174	139	110	137	225	168
Extra Stock	54	72	76	60	129	86	25	46	20	67	30	40	..	..	..	..	..	..	..	..
Total number of animals each year	350	451	463	497	608	716 (*a*)	527 (*b*)	775 (*c*)	580	866	799	769	1226 (*d*)	728 (*e*)	868 (*f*)	950 (*g*)	1020 (*h*)	879 (*i*)	1425 (*j*)	1367 (*k*)

(*a*) Including 23 Channel Island cattle. (*b*) Including 26 mountain sheep. (*c*) Including 83 mountain sheep and 37 black-faced and Cheviot sheep. (*d*) Including 31 Channel Island, and 22 Sussex, and 26 other cattle; also 43 mountain sheep. (*e*) Including 75 Sussex cattle and 57 Romney Marsh sheep. (*f*) Including 5 Welsh cattle and 52 Shropshire Down sheep. (*g*) Including 66 Lincoln sheep. (*h*) Including 58 Scotch cattle and 173 mountain and Cheviot sheep. (*i*) Including 19 foreign cattle and 4 foreign sheep. (*j*) Including 15 Channel Island cattle and 273 Hampshire Down sheep. (*k*) Including 26 Welsh and 45 dairy cattle, also 184 Shropshire Downs, 20 Cheviots, and 45 Welsh sheep. The returns of the poultry department commencing at Lewes are not given, as this department of the show is about to be discontinued.

In drawing up a Report of the Society's meeting at Chester, it will be well, first, to touch upon the origin of our established breeds, and then take the classes as they occur in the Society's programme, commencing with

Established Breeds of Cattle.

Short-Horns.—The modern progress of this remarkable breed of animals is generally well known, but it is much to be regretted that we have no really authentic account of their origin. We have only a tradition pointing to their introduction from the Dutch provinces about the close of the seventeenth century into Holderness in Yorkshire. The short-horn combines in an eminent degree the qualities which have generally been considered desirable in good and profitable animals. They have realized for their breeders enormous sums of money, and both at home and abroad they are in increasing request. In their early career they were designated as large and coarse animals, with a productiveness at "the pail" that would now excite incredulity. Such has been the result of good management, together with a knowledge of nature's dictates, that these animals have been completely remodelled in "shape, quality, and popularity." Among the earliest of them were the old Teeswater, said to have been the foundation of the late Mr. Charles Collings' celebrated herd. Mr. Collings, as a breeder, manifested a superiority of skill which, in a brief period, secured him an ample fortune.

It is to be regretted that this celebrated breeder, in common with the late Mr. Bakewell, of equal celebrity, left us no record of his views and plans in the art of breeding or rather improving domestic animals. In either case we have *primâ facie* evidence that the object was to reduce a rugged and large frame down to symmetrical proportions. It is now the more difficult task of our modern breeder to maintain these elements, and yet keep up the vigour and requisite constitution of a more "artificial animal."

The improved short-horns evidently date their first public introduction and popularity from Mr. Day's exhibition in 1801 of the "Durham ox"—an animal produced from a first cross with a common cow, by the famous bull "Favourite." Mr. C. Collings' sale of improved short-horned cattle took place on the 11th of October, 1810, with the following results:—

17 Cows were sold for	£2802	9	0
11 Bulls ditto	2361	9	0
7 Bull calves under one year old, ditto ..	687	15	0
7 Heifers, ditto	942	18	0
5 Heifer calves, ditto ditto	321	6	0
47 sold for	£7115	17	0

Averaging 151*l.* 8*s.* $\frac{1}{4}$*d.* each!

Mr. R. Collings' sale followed, 29th September, 1818. At this remarkable sale

34 Cows sold for	.. ..	£4348	1	0
17 Heifers	.. ..	1351	7	0
6 Bulls	.. ..	1410	3	0
4 Bull calves	.. ..	748	13	0
61 sold for	.. ..	£7858	4	0

Averaging 128*l.* 16*s.* 5½*d.* each.

After the decease of Mr. Christopher Mason the then celebrated "Chilton herd" was sold on 1st September, 1829, when

64 Cows and heifers realized	.. .. ..	£3320	2	0
38 Bulls of all ages	.. ..	2218	13	0
102 sold for	.. ..	£5538	15	0

Average, 54*l.* 6*s.* each.

These were the three leading sales that preceded the formation of the Royal Agricultural Society, and it is to these and subsequent sales that the country is indebted for the distribution of so many first-class animals, the foundation of our present "established breed."

The formation of the Royal Agricultural Society, and its annual meetings for the display of these animals, have done much to bring them under public notice. If an illustration of this be wanting, we can point to the Society's first meeting at Oxford, when the late Mr. Bates so successfully carried off all the short-horn prizes, except the bull-calf (for which he did not exhibit), with his descendants from "Young Duchess"—a heifer purchased at Mr. Collings' sale. This was indeed an important starting point in the annals of our meetings. This "Duchess" family of short-horns—till then comparatively unknown—then showed to the *general public* a class of animals of unequalled excellence of form and quality of flesh. In subsequent years we had other equally distinguished animals exhibited to our notice, whose descent from the earliest blood of Messrs. Collings, Mason, &c., was equally well established.

The cattle bought at the sales just enumerated were evidently the foundation of the three noted tribes of short-horns, known as the Mason (of Chilton), the Bates, and the Booth blood. Colonel Cradock had also some cattle from them, from which descended what is known as the "old Cherry" tribe. Lord Spencer bought largely at the Chilton sale, and many of the best animals were removed to Wiseton, and were afterwards known as the "Wiseton" herd. There are indeed so many descendants from the "old stocks," that it would be quite invidious to dis-

tinguish any of them, and the more so as Mr. Strafford holds the registration of these and other important families, with their descendants, &c., in the numerous volumes he has published of the 'Short-Horn Herd Book.'

With one exception—that of Windsor—the Chester Meeting has brought together more animals than any other show during the twenty years of the Society's existence.

At Oxford, our starting point, there were only 27 entries in short-horns: these steadily increased to 115 at Newcastle, receded to 68 at Exeter (the land of the Devons), rallied again to 176 at Windsor, fell back at Lewes to 64, since which they have again increased, and reached the number of 126 in the six classes at Chester.

The progress of the breed during the last twenty years has been most wonderful, and their value has become more generally admitted, as they have been distributed over the island. The early tribes, before mentioned, maintain their pre-eminence, showing that none but the purest bred can win, when meeting upon fair and honourable terms at these great national gatherings.

It has been already mentioned that Mr. Bates first distinguished the short-horns at the meetings of the Royal Agricultural Society by his exhibition of the Duke and Duchess tribe. He had other tribes of short-horns which were crossed with bulls from his Duchess cows, such as the Foggathorpe, Waterloo, Wildeye, and Cambridge Rose tribes; but the Duchess tribe were always considered the best, and uniformly brought the highest prices.

At the decease of Mr. Bates the Kirkleavington herd was brought to the hammer by *Mr. H. Strafford*, on the 9th May, 1850.

48 Cows and heifers realized	£3232	19	0
20 Bulls, different ages	1512	0	0
68	£4744	19	0

Averaging 69*l.* 15*s.* 7*d.* each.

In 1853 the famous Tortworth Court Collection of short-horns was sold. The executors of the late Earl of Ducie directed Mr. Strafford to offer them for public competition on the 24th and 25th August, 1853.

49 Cows, heifers, and calves sold for ..	£6867	0	0
13 Bulls and bull calves	2494	16	0
62	£9361	16	0

Averaging 151*l.* each!

Then followed the Bushey Grove sale, 22nd May, 1857, when 59 animals, cows, heifers, bulls, and calves, realised 5317*l.* 4*s.*, or an average of 90*l.* 2*s.* 5*d.* each.

Mr. Bolden, of Springfield Hall, Lancaster, sold to Mr. Thorne, of New York, two bulls from Duchess cows, viz. "Grand Duke" (10,284) and "2nd Grand Duke" (12,961), at 1000 guineas each, yet the Bates tribe, though admirable in their hair and quality of flesh, were by no means perfect in form. Latterly, since they have fallen into many hands, a number have been crossed by Booth's bulls and *vice versâ*, which seems to have succeeded in a good many cases extremely well. "Grand Turk" (12,969), bred by Mr. Bolden, and sold at Mr. Ambler's sale last year for 300 guineas to Mr. Thorne, of New York, is an example of this; he was got by "Grand Duke" (10,284), from "Young Rachel," a cow of Mr. Booth's blood. The cow "Britannia" from Mr. Booth's "Bridget," by the same bull, and sold at the same sale to Mr. Torr at 270 guineas, is another instance.

The Booth blood is now by almost universal consent recognised as the best tribe of short-horns in existence; they trace back to "Suwarrow" (636), bred by Mr. R. Collings, and the two bulls "Pilot" (496) and "Albion" (14), bought at the Collings' sale by the Messrs. Booth. These turned out extraordinarily good getters, and gave this herd a good start, which has been maintained and carried on by zealous and skilful management, so that at the present time it is very popular.

Nearly three-fourths of the prize animals at the great exhibitions of the kingdom are either entirely of this strain of blood or have crosses of it. So much sought after are the bulls of this herd by breeders in all parts of the kingdom, that some of the more popular animals of the herd are bespoken six deep for hire for the season; a number are let for 200 guineas each, and not a few above that sum.

The stock descended from old "Barmpton Rose," by "Thick Hock," has proved exceedingly good in the hands of several breeders; they have taken more prizes than any other family of short-horns in England. Several of her descendants have been sold at prices not less than 300 guineas, and as high as 400 and 500 guineas. "Master Butterfly," also a descendant of "Barmpton Rose," was sold at Chelmsford for 1200 guineas.

The "Old Cherry" tribe, if so it may be called, is famous for having produced some extraordinary sires, viz.—"Magnum Bonum" (2243), "Gainford" (2044), "Mussulman" (4525), "Mehemet Ali" (7227), "Guardian" (3947), "Colonel" (5428), and "Thorpe" (2757); also some famous prize cows and heifers, viz. "Melrose," "Matchless," "Emma," &c. &c., bred by Mr. Crofton, by "Gainford" (2044). Mr. Douglas's celebrated 2-years old heifer, "Queen of Trumps," is a great-granddaughter of "Old Cherry." These animals were all re-

markable for symmetry, quality, and heavy flesh. "Mussulman" was the sire of Mr. Booth's "Buckingham" (3239), from the celebrated cow "Bracelet;" and "Buckingham" was the sire of a great many of Mr. R. Booth's celebrated prize animals, and also regarded as the best getter of heifers in England.

The "Mason blood" has not been so successful at the agricultural exhibitions. They were, as a family, rather light of flesh, and not so squarely grown as the Collings sort.

Amongst the more successful herds of the present day, after that of Mr. Booth of Warlaby, is that of Colonel Townley, who purchased the herd of Mr. Eastward in 1849, and thence dated his distinguished career as a short-horn breeder; having long been a most triumphant winner, gaining the Irish Challenge Cup, value 100 guineas, which had to be won three years in succession; and the Royal Dublin Society's Cup, value 120 guineas, given on the same terms. On winning these two cups the gallant Colonel gave each Society another cup to be competed for upon similar terms, but excluding his own herd.

At the International Show in Paris, 1856, he exhibited in only three classes, and took the first prizes, with a gold medal for *extra merit*. At the Yorkshire Show, held at Sheffield, he took Mr. Bright's handsome prize of a Timepiece for the best collection of animals in the yard.

The most remarkable event in the history of this popular herd is the fact that the cow "Victoria" won the first prize and gold medals at the Birmingham and Smithfield *fat* stock Shows in 1857; and after her return to Townley Park produced a fine healthy bull calf, which is doing well! A circumstance opposed to the general remark, that "fat cows will not breed." The Colonel has won twenty gold medals, and above fifty silver medals, besides his numerous money-prizes, in the short space of nine or ten years.

Mr. Fawkes, of Farnley Hall, is another successful breeder; and considering that he has never shown any animals but young bulls, it may be truly written that his herd is first-rate as well as of first-class descent. Mr. Fawkes has had a liberal sale for his animals at home, as also to America, Australia, and France.

Mr. Torr, of Aylesby, has one of the most select herds of the day, but rarely exhibits at the national shows. He is a stanch supporter of the Booth tribe of short-horns. Occasionally he makes a good display at the Lincolnshire meetings; but then it is with some half-dozen cows from his general herd. The names of Messrs. Bolden, Maynard, Wetherall, Carr, and Barrowby, Lord Feversham, Sir C. Tempest, Viscount Hill, Messrs. Majoribanks, Grundy, Ambler, and Stratton, are alike familiar to the ear. The latter gentleman, Mr. Stratton, of Broadhinton,

appears to have struck out a line or breed of his own. His remarkable herd has been chiefly bred from *one cow*, "Old Mossrose." This cow was bred from a cow purchased in Warwickshire (evidently a true short-horn). From "Old Mossrose" has sprung a considerable herd, no less than forty of which have been prize winners, some of them taking as many as twenty prizes each: some few have been successful at the Royal Society's meetings. Three prizes and two gold medals were awarded to them at the Paris meeting in 1855; and eighteen medals—fourteen silver and four gold—have been awarded to them from the Birmingham and Smithfield Club shows; which clearly testifies that they possess good points, and a good constitution. Up to September, 1858, Mr. Stratton had won 491 local and other prizes, amounting in round numbers to 3217*l.* 4*s.*, besides seven gold and fourteen silver medals. Mr. Stratton has been a breeder of short-horns about twenty years.

Mr. Douglas, of Athelstaneford, has been the most successful exhibitor of the past season. Mr. Douglas has won the three national prizes with a two-year-old heifer "Queen of Trumps;" also the three challenge cups of Ireland, valued at 350 guineas, upwards of 200*l.* in money prizes, and six gold medals. Last year his cow, "Rose of Athelstane," obtained the three national prizes, and in 1854 her dam, the "Rose of Summer," did the same.

The foreign trade in short-horns is at the present time an important element of success in breeding first-class animals as a remunerative department of agriculture. In America, Australia, France, and indeed over the whole continent, a demand has sprung up which there can be no doubt is only in its infancy; for independently of cultivating the pure breed in those countries, its use in crossing the native breeds for their improvement is of vast importance.

I may refer here to the 'Herd-book,' originally started in 1822, and edited by Mr. George Coates of Pontefract, but now conducted by Mr. Strafford, Euston-square, London, as the *authentic* register of the short-horned breed of cattle from their earliest existence, or at least from the date of the earliest registers kept by the first improvers of the breed.

The number of entries contained in the first five volumes issued in the course of twenty years amounted to 6699.

In 1842 Mr. Henry Strafford succeeded to the editorship, and has conducted the work up to the present time. During the period ending 31st December, 1857, he has published seven additional volumes, which contain the entries of no less than 15,537 bulls, together with cows and their produce during the past fifteen years. In future the 'Herd-book' will be made up

at shorter intervals. It is confined to the British Isles. America, Australia, and France have now their own 'Herd-books,' founded on this, the parent one, to which most of the pedigrees refer in their original descent.

The general exhibition of this beautiful and rapidly increasing breed of animals at Chester did honour to the Society's meeting. In Class I. we had 30 noble animals, the first prize being carried off by Lord Feversham's old bull "5th Duke of Oxford," bred by the late Lord Ducie at Tortworth Court, and descended from the Bates blood. The immense substance of this bull, together with his fine touch, must have gone far to establish him in so high a position.

The second prize was awarded to an animal which had been in a fortunate position at Chelmsford. A renewal of good fortune is indeed a triumph, especially under such competition. Although this was a good *class* of aged bulls, yet we have seen animals more decided in the true characteristics of the short-horn breed.

Class II.—*Yearling Bulls:* 20 entries.—With some few exceptions it was not by any means an inviting class, as representing the future of the breed. Among the best we noticed two young bulls, exhibited by Mr. Fawkes; also the prize bulls, including "Great Mogul," by "Grand Turk." Mr. Torr's "Silver Star," by "Vanguard," was also worthy of his sire.

Class III.—*Bull Calves:* 20 entries.—This was an interesting class, and furnished some good animals, but we have seen the general character of this class stand better.

Class IV.—*Cows in Milk or Calf.*—This was the leading class of the breed, and contained some extraordinary animals. Mr. Booth's prize cow "Nectarine Blossom," by "Crown Prince," dam "Hawthorn Blossom," was a magnificent beast; her form was perfect. Mr. Stratton's second prize cow was a good animal, but her age must have carried some weight with it to enable her to reach so high a position. Mr. Wetherall's cow "Moss Rose" was highly commended by the Judges; indeed the Judges highly commended the class generally. It must have been difficult to select the prize animals. Some of the cows were, however, so excessively fat, that the instructions given to the Judges as to the breeding capabilities of the animals may have assisted them.

Class V.—*Short-horn Heifers in Calf or in Milk.*—This is usually a fine class, and its character has again been fully maintained. Mr. Douglas's prize heifer, "3rd Queen of Trumps," is truly a gem of uncommon excellence, as is also his celebrated white heifer, "Venus de Medicis." The Hon. and Rev. Noel

Hill exhibited his "Lady Rockingham" heifer, which was placed second, and is a good-looking stylish animal. The heifer "Venus de Medicis" was highly commended, as was also Colonel Townley's heifer, "The Rose of Townley."

Class VI.—*Yearling Heifers:* 33 entries.—Mr. Booth's old blood was here again triumphant; his very beautiful and promising heifer, "Queen of the Isles," being placed by the Judges first on this long list. Close upon her came the second prize animal, of the "Frederic" blood, exhibited by Colonel Townley, and the "Sweetheart" yearling heifer exhibited by Mr. Grundy of the Dales. This animal, having been since purchased by Mr. Douglas of Athelstaneford, will be seen again, and possibly again, at future shows: she is a choice specimen by "Horatio," dam "Sweet Lucy." The most remarkable feature of the class was the exhibition of ten yearling heifers by Colonel Townley, several of which were heavy in calf.

In conclusion, a general review leads me to the opinion that, although the short-horns have now become more the general stock of the country, and were shown in unusual numbers at Chester, they were not superior there to the best-bred animals that have been exhibited in former years. The young animals, especially the *males*, are not improving as they ought from such parentage as we have been accustomed to see at previous shows. The high condition of the cow and heifer stock is unnatural and opposed to common sense. Are such animals really in a state for breeding *and* milking—one (at least) of the uses of the beast? It would be well if more attention were paid to the lean meat of a short-horn, and less to superfluous fat. It would be better to err on this side with our first-class bulls rather than to encourage male animals of a smart heifer-like cast, without lean meat—"quality, *with* substance," being really essential.

Herefords.—This race of cattle, which has long been distinguished for its splendid oxen, was shown in greater numbers at Chester than at any previous meeting of the Society, with the exception of Shrewsbury, and formed one of the most attractive classes. Their placid and beautiful countenances—denoting that general mildness of temper so necessary for the success of the grazier—together with their substance of flesh in proportion to bone, could not fail to strike all who beheld them. The Herefords clearly come under the same denomination as the Devons, viz. the "Middle-horn" tribe of cattle: they are considered to be an aboriginal breed, and descended from the same stock as the Devons. Little is known respecting their origin, further than that for many generations they can be traced as the peculiar breed of the county from whence they take their name. Yet a few years

since they were not of the same uniform appearance of colour as now, there having been some herds self-coloured like the Devon and Sussex breeds, and opinions have been published that this was their original character. Subsequently we find the grey, the mottled, and the white-faced, each with their distinct admirers, and their successful breeders. This subdivision of a race of animals (it may be readily imagined) would occur from the use of a self-coloured bull with a white-faced cow, or the reverse; but that the race was originally red with a white face, is clearly indicated by the almost perfect uniformity of colour which the breed of the county now presents. The Hereford cattle have hitherto been held in high estimation for the rapidity with which they feed and the quality of their flesh, together with the working powers of the oxen, which display the activity of the Devon combined with the strength of the Durham.

The calves usually run with their dams in a natural state—a rude state of things which the breeders ought to alter, as its present effect is to depreciate the value of the whole race. In this thickly populated kingdom it is necessary that both milk and flesh be produced. We hope to be excused for making this allusion, particularly as we are aware that not only can these cattle be greatly improved by cultivation, but that their milk is of a superior quality, and yields a return equal to that of any other breed possessing similar pretensions to flesh.

Among the earliest breeders of celebrity, of whom anything is known, the names of Tully, Yeoman, Skyrene, Williams, and Weyman, may be mentioned as some of the most successful. Subsequently those of Tomkins, Price, Hayton, Jones, Hewer, Jeffries, Knight, and Smithies. These, too, have passed away; and in our present day we see recorded in the Society's Journals an increasing number of competitors from different parts of the kingdom. This proves that the value of the breed is becoming more appreciated. A few years since they were almost exclusively in the hands of the tenant farmers of their native county; they now form the principal breed of the counties of Monmouth, Radnor, Brecon, Salop, and parts of the counties of Gloucester, Worcester, Warwick, Stafford, Wilts, Herts, Dorset, Somerset, and Cornwall. There are also some good herds in North Wales and Scotland, for which districts their hardiness of constitution, thick but mellow hides, wavy, soft, and moderately long hair, render them peculiarly adapted. Recently a considerable number have been exported to America and the Australian colonies, where they are rapidly gaining favour. It is much to be regretted that no correct pedigree of this breed was kept until T. C. Eyton, Esq., of Eyton Hall, Salop, exerted himself to collect information, and condense it in a 'Herd-book.' His first volume appeared in 1846; but

although he urged the necessity and value of such a work, it was not appreciated, and after publishing another volume in 1853 he expressed his intention of discontinuing it. The late W. S. Powell, Esq., of Hinton Court, Hereford, then purchased the copyright, and commenced the third volume: but his sudden death stopped the progress of the work. Breeders, however, began to see its value from the question of pedigree being repeatedly raised by those who sought to purchase, and the copyright was purchased of the representatives of the late Mr. Powell by the Committee of the Herefordshire Agricultural Society, who selected Mr. Duckham, of Baysham Court, Ross, to conduct it. This he has done with great perseverance; and although only twelve months have elapsed since he commenced his labours, he has published his first volume (the third of the work), and for the first time has added the cow pedigrees and their produce. The number of bulls in the two first volumes are 901; they now number 1477.

I now refer to the show of this breed at the Chester Meeting.

Class I.—*Aged Bulls:* 9 entries.—These animals displayed such uniformity of character, symmetry, and substance, that it must have puzzled the Judges to distinguish any of them. The prize bull, the property of Mr. Price, Court House, girthed 8 feet 7 inches; another highly commended bull, shown by Lord Bateman, girthed 8 feet 9 inches. These exceeded in girth the first-prize old bull in the short-horn class by 8 inches—his girth being 8 feet 1 inch. The two Hereford bulls were a few months the oldest. The prize aged Devon bull girthed 7 feet 8 inches. The bulls exhibited by Mr. Rea, of Westonbury, Lord Bateman, and Lord Berwick, were all first-class animals, and deservedly received the high commendation of the Judges.

Class II.—*Young Bulls:* 15 entries.—Five of them were distinguished by the Judges. The two prize bulls were promising, thick-fleshed animals, but their colour might have been better. Considering the number in the class, there was room for improvement. It is somewhat singular that the five selected bulls in this class were all shown by different breeders from those in Class I.

Class III.—*Bull Calves:* 14 entries.—Among them were several promising animals; but, considering the number, they did not (collectively) rank so high in estimation as the other classes.

Class IV.—*Cows in Milk or Calf:* 8 entries.—This class was better than usual. In addition to the two prize animals and one highly commended, the Judges "commended the class generally."

Class V.—*Heifers in Milk or Calf:* 8 entries.—The prize animals were especially good. Of the eight exhibited scarcely one could be considered unfit for a first-class herd.

Class VI.—*Yearling Heifers:* 14 entries.—This class contained many beautiful young heifers. Some of these will be distinguished animals at subsequent meetings.

As a class of animals, the Herefords at Chester exhibited a greater uniformity of cast and quality than at any preceding show. They were upon their own ground, and an extra effort had evidently been made by the principal breeders.

The Hereford steer from the earliest date has always been a popular beast with the grazier. They were formerly sold as oxen at the age of five to six years, and as such distinguished themselves at the Smithfield Christmas market and Smithfield Club shows in bygone years. They are still sought after; but come out as first-rate steers at two to three years old. To be fully appreciated they should be seen at the local fairs, where, from their uniformity of flesh and colour, they make a great display.

Devons.—The North Devon cattle have been long recognized as one of the earliest English breeds. Even in 1808 they are mentioned in Vancouver's Report of the Farming of Devonshire "as an important breed of animals, active at work, and their aptitude to fatten unrivalled." Their natural locality is around North and South Molton; but verging away from this neighbourhood in every direction, more especially to the eastward, where we find the Wiveliscombe and West Somerset classes of Devons; they then merge into other breeds, or are changed by climate and circumstance. The true type of the "old Devon" is peculiar to North Devon. Here they have long revelled in their bracing yet humid air, where nature clothes them in early autumn with dark curly coats, well adapted to their native home, at the foot of the Exmoor mountain range.

They were amongst the earliest breeds to be removed from the home of their fathers; but they did not enjoy themselves on distant soils in equal ratio with other breeds, especially when destined to consume artificial food for the purposes of a corn farm; yet, as converters of vegetable into animal food—breed against breed—they were found to return as much per acre, or for weight of food consumed, as any other breed.

The Devon steer is described even from early times as being much sought after by the graziers and dealers from the Midland and South Midland counties. Vancouver states (1808) that the Devons were then declining in their general standard of excellence and numbers. He traces it to "the great demand which has been made for these cattle from other parts of England, where

the purchasers (Mr. Coke and others) spare neither pains nor price to obtain those of the highest proof and beauty." Great merit is due to the late Mr. Francis Quartly, of Molland, who perceived that the best animals were being drawn from their native soil, and systematically purchased the choicest cows he could procure. Mr. T. D. Acland, in his Report of the Farming of West Somerset, makes honourable mention of Mr. Quartly's patriotic and successful exertions. About the year 1831 cattle shows began at Exeter. Some good Devon breeders carried off the early prizes; but in November, 1835, Mr. Quartly allowed his nephews to enter in all the twelve classes at Exeter, and they brought home the twelve prizes. In the previous year Mr. Quartly gained eight prizes out of ten.

As a proof of their continued zeal and judgment, I may mention that at the Royal Agricultural Society's meeting at Exeter, in 1850, seven prizes were awarded to the Messrs. Quartly and two prizes to animals bred by or from their stock; leaving only one prize for the 64 Devons shown by the other competitors. Mr. G. Turner, of Barton, Exeter, is also a celebrated breeder in South Devon. Captain T. T. Davy's grandfather was an early and zealous breeder of North Devons as far back as 100 or 120 years ago. At his decease Mr. Wm. Davy had a portion of the herd, and bred some first-class animals, which were subsequently bequeathed to his son Mr. James Davy, of Flitton, who has turned them to good account. Mr. Mogridge, of Molland, has also been a very successful breeder from the stock of Messrs. Quartly; and although he never exhibits himself, many of his animals have been great winners while in the hands of the Prince Consort, Mr. G. Turner, and others.

Captain T. T. Davy has still retained some of the old family sort. It is to this indefatigable gentleman that Devon breeders are indebted for the 'Devon Herd-book.' He published his first volume in 1851, the second in December, 1854, and the third in 1858. It is admitted that these volumes contain a faithful report of the pedigrees of the greater number, if not all, of the best Devons. The fact that these Herd-books have been republished in the United States is strong corroborative evidence of their value. In this 'Devon Herd Book' mention is made of 29 *prize* bulls; 27 of them are descended from the bull "Forester." Again, there are 34 *prize* cows; 29 of these are descended from the old cow "Curly:" both bull and cow are of the Quartly tribe of Devons.

The competition in the Devon classes at Chester was confined to 37 animals. These were the pick of the breed. The smallness of the number was due to distance from home and jealousy of being beaten. But the more danger the more honour.

Class I.—*Aged Bulls:* 5 entries; all of which were favourably noticed by the Judges. Two received prizes, one was highly commended, and two commended; yet none were perfect animals.

Class II.—*Young Bulls:* 5 entries.—These were all noticed as animals of the first order: two received prizes, two were highly commended, and one commended. Mr. Quartly's prize bull was a very thick-fleshed good animal.

Class III.—*Bull Calves:* 8 entries.—Mr. Turner's, which received the first prize, was a nice calf: there were also two or three others of merit; but this was not a striking class: they appeared to disadvantage, owing to many of them being too young for exhibition.

Class IV.—*Cows in Milk or Calf.*—There were six splendid cows out of nine exhibited. The two prize cows shown by Mr. Quartly were true types of the rich quality and fine symmetry so peculiar to the real North Devon breed. Mr. Davy, Mr. Turner, Mr. Merson, and Mr. Umbers, also exhibited cows of great merit, all of which were noticed by the Judges. Two had prizes, two were highly commended, and two commended. This class was equal to that of any former year.

Class V.—*Heifers in Calf or Milk.*—There were only three exhibited, but they were indeed good ones, and the third best received a high commendation: in fact, it must have been a delicate decision.

Class VI.—*Yearling Heifers:* 8 entries.—Mr. Quartly carried off the first prize with a real "Gem." Mr. Turner had also two very select heifers, one of which was placed second and the other highly commended.

The Devons were justly designated the *élite* of the yard. I conclude these remarks with the words of a short-horn friend, who accompanied me through the Devon classes. He exclaimed, "I am delighted. I find we short-horn men have yet much to learn of the true formation of animals; their beautiful contour and extreme quality of flesh surprise me." This remark was made when going over the cow class.

With a view to public information and to test how far the girth of animals confirmed their merits, whereby some data might be formed, I carefully measured the girth of all the prize animals and some of the commended ones in the several classes of the "*established breeds*" of cattle, with the results which are given in the following Table:—

AVERAGE AGE AND GIRTH OF PRIZE CATTLE.

Number of the Class.		Number of Entries.	Average Age of Prize Animals.		Average Girth of Prize Animals.	
			Yrs.	Months.	Ft.	Inches.
SHORT-HORNS.						
Aged Bulls	1	30	4	7¼	8	3½
Yearling Bulls	2	20	1	9½	7	2
Bull Calves	3	20	0	9¼	5	8
Cows	4	12	3	9	7	10
Two year old Heifers ..	5	11	2	5	7	4½
Yearlings	6	33	1	4	6	5½
		126				
HEREFORDS.						
Aged Bulls	1	9	4	5	8	3
Yearling Bulls	2	15	1	10¼	7	0½
Bull Calves	3	14	0	10¾	5	11½
Cows	4	9	7	8	7	2
Two year old Heifers ..	5	8	2	7¼	7	4½
Yearlings	6	14	1	9½	6	6½
		69				
DEVONS.						
Aged Bulls	1	5	3	6	7	5
Yearling Bulls	2	5	1	6¼	6	2
Bull Calves	3	8	0	8¼	5	2
Cows	4	9	6	2½	6	9¾
Two year old Heifers ..	5	3	2	6	6	10
Yearlings	6	7	1	7¾	6	1
		37				

OTHER ESTABLISHED BREEDS.

In the classes set apart for the "other established breeds not being Short-horns, Devons, or Herefords," there were in the six classes 22 animals entered, viz. 2 Alderneys, 4 Ayrshires, 4 polled Norfolks, 5 polled Angus, 2 Welsh, 3 West Highlanders, 1 Galloway, and 1 Brahmin. There were five first prizes to contend for. Three of these prizes were won by the Earl of Southesk, of Kinnaird Castle, N.B., for his polled Angus bull, polled Angus cow, and polled Angus heifer, all of which were good specimens of their breed. Another was taken by Lady Pigot of Chippenham Park, Cambridge, for a young West Highland bull, and the fifth by Lord Sondes of Elmhall, Norfolk, for his polled Norfolk heifer; these were also considered good animals. There were 6 others noticed by the Judges, viz. 2 Alderneys, 1 polled Norfolk, and 2 polled Angus highly commended, and 2 Ayrshires commended.

These entries show that the "other established breeds" were

not strong in numbers, although they were fair specimens of their several breeds. The Sussex men, from some cause or other, did not exhibit at this meeting, though at Windsor there were 22 entries, and at Lewes, in 1852, 75 entries of Sussex cattle. The Sussex cattle showed to most advantage at Lewes, and on that occasion certainly made a favourable impression on the public. They were amongst the earliest recognized breeds in our island, and bear a considerable resemblance to the Devons. The Sussex and Scotch Highlanders are specimens of the "middle-horn" class of cattle, said to be indigenous to our country.

The Horse.

The breeding of the horse is a national subject, but as yet has not been treated as such. There is a want of system in our arrangement and management. In fact he is not a popular animal to breed. If we discuss the subject with the arable farmer, and press upon him the importance of this "lucrative branch," he at once meets you with "It's not my business." If with the grazier, he replies, "They disturb my cattle." If with the amateur, he has "no fields or sheds." If with nobles of the land, "None but a thoroughbred can ever pay."

These objections are vague, but there is a certain amount of truth in them. Hence the production of this valuable animal is generally ill-regulated and unsystematic. As instances to the contrary, however, where *system* is adopted, we may point to the Yorkshire coach-horse, the Suffolk punch, the Lincolnshire dray-horse, the Clydesdale horse, and the mountain pony.

In the earlier periods of our history oxen alone were employed in England for the plough. To King John we were first indebted for the introduction of one hundred selected stallions of Flemish breed, which mainly contributed to the foundation of our noble species of draught horse; Edward II. and Edward III. contributed alike to the improvement of the English horses "for war and agriculture." Henry VIII. in the fifteenth century prohibited the exportation of English stallions. It had been the custom in his reign to keep large herds of horses indiscriminately in the pastures and common fields. The consequence of this was that the progeny presented a strange admixture and deterioration of the breed; subsequently an act was passed prohibiting stallions from being turned at large. Henry VIII. passed an act, whereby he affixed a certain standard of height for every entire horse, below which no horse should be kept. Charles I. established races in Hyde Park and at Newmarket. Charles II. sent his Master of the Horse to the Levant to purchase brood mares and stallions; these were principally Barbs and Turks. William III. was a

patron of the turf, and introduced every variety of Eastern blood. Then commences the history of our thoroughbred horse, until we find a record of his pedigree carefully registered in the "Stud Book."

The Cavalry Horse.—Our war horses were formerly large and of heavy calibre: they now possess more breeding but less substance, and they too frequently represent a singular compound of many crosses. There are few subjects that demand the attention of Government more than the production of a "cavalry horse." The coach-horse has also been remodelled from the old clumsy six-mile-an-hour horse into an elegantly shaped animal, having high knee action—the great essential. The Cleveland bay has had much to do with this improvement. The Cleveland mare being crossed with a three-fourths or thoroughbred horse of sufficient substance and height, the produce is the coach-horse now so much in repute. Their production is mainly confined to Yorkshire; subsequent crosses with the higher bred stallion produce many a good weight-carrying hunter and hack.

The Hunter.—The altered character of fox-hounds, and the additional speed they have acquired, compel all men to ride a better horse. Stoutness is still required, but blood has become an essential quality. In Devonshire the old thick half-bred horse may get along tolerably well in the enclosed country, but for Leicestershire the hunter must now be nearly or quite thoroughbred.

The *Hackney* is even more difficult to breed than the hunter. A hack must be perfect in all that relates to fine action, temper, symmetry, and size; he must not be below or above a fancy height. He must avoid the "daisy cutting" as much as the "high knee action," and go smoothly along at a *gliding*, yet ten-mile-an-hour, pace.

The Pony.—The mountain pony is an indigenous animal peculiar to our mountain ranges, whereby the rough grasses are turned to account, which would otherwise decay and be lost. The original pony has been much improved; the native pony of the New Forest in Hampshire was enlarged and improved by the presence of "Old Marske" amongst them; the Exmoor pony, by an infusion of the English thoroughbred and Dongola horse; the Welsh pony has been crossed with the Norwegian; the Dartmoors are nearly extinct; the Highland pony is still the old hardy animal nature formed; the Shetland pony of the northern Scottish isles is still diminutive, but beautiful. The infusion of larger males amongst the old mountain race has increased their bulk, while their pony form and hardy constitution have been preserved. The severity of winter-storms drafts many an inferior animal from this larger breed, leaving the breeder to reflect on

the inevitable operation of nature's laws. The Galloway is indeed a treasure when well produced. The first cross from the pony mare with a small thoroughbred horse is generally the real animal for safety, quickness, and endurance. There is ample record of the wonderful performances of this class of animal, either for the field, the road, the park, or lady's carriage. The best are graceful indeed. Being a Galloway breeder myself, and to some extent from the Exmoor pony mares, I have taken the opinion of a first-rate judge as to the qualities required in them. He writes to me—"I wish you to breed some Galloways (a few to begin with) of the following kind: long, low, and full of quality; deep shoulders, light necks, and small heads, with large nostrils and hawk's eyes, for which I will give 120*l.* each."

The *Cob* is a more difficult animal to breed, and is more frequently the result of chance than of any well-matured system of breeding. The real cob, from his enormous strength and robust form, must partake rather freely of the active carthorse, combined with a pony mare, or *vice versâ.*

The *Draught Horse* has other objects to fulfil: hence the Society divides these animals into distinct classes, viz. the agricultural horse and the dray-horse. The *heavy* black, brown, bay, and grey horse is best adapted for the London dray and such other purposes as require power by weight of carcase. The Suffolk, Clydesdale, and active clean-legged bay and brown horses are best adapted for farm work.

The *Dray-horse*, in its true sense, is an animal produced from the early crossing of our English mares with robust Flemish horses. They are only produced in such districts as are proverbial for their deep rich pasture lands, such as the Lincolnshire and other eastern marshes, also those of Somerset and some rich midland pastures. South Lincolnshire has been most famous for this class of horse; great numbers leave it as colts for the upland counties, where they are gently worked for a few years, and subsequently sold to the London and other dealers. The breed being a *general* one, it would be unwise to mention any names as leading breeders. The autumn fair at Thorney, on the borders of South Lincolnshire, as also Rugby and Waltham in Leicestershire, are justly celebrated for their display of heavy cart colts. They are usually sold at two and a half years old. The agricultural or single harness horse is an animal upon which devolves the quick movement of the farm. With our changing agriculture, this horse has to a great extent been remodelled, but there yet remains the great work of more generally distributing him throughout the country. Take the best Clydesdale horse as a pattern: he is all you want—quick, staunch, enduring, and hardy; his cast,

style, and barrel-like form, are each conducive to his daily work, especially in a hilly country.

The Clydesdale horse owes its origin to one of the Dukes of Hamilton, who crossed some of the Lanark mares with stallions that he had brought from Flanders. The southern parts of Scotland, and some of the English counties, are supplied from this district; they make a great display at the Glasgow and Rutherglen fairs, where the dealers from the south go to meet them. The Suffolk horse is another admirable breed of the English draught-horse for the farm, the cart, or the lighter dray work. Though peculiar to the county from whence they take their name, they have of late years found their way into almost every corner of the island. The old "Suffolk Punch" has now become extinct. It was a thick short-legged description of horse, with rather a plain head, and a short low forehead; it could nevertheless trot from seven to eight miles an hour in light harness, and was usually ridden by the farmer. The Suffolk horse is invariably chesnut, although of different shades; there being the *dark*, *bright*, *silver-haired*, and *red chesnut;* all of these have their admirers; the pale coloured being least fashionable. Since the formation of the East Suffolk Agricultural Society in 1831 it is not uncommon at these meetings to see upwards of 100 of the modern Suffolk horses shown for the prizes, and all of a chesnut colour. It is generally allowed that a material change has been made in the form and style of this class of horse, but there are doubts among the older heads if they are at all better than their forefathers of the punch family, who were staunch and good at everything; at any rate good ones are more common now. The leading breeders of this horse are Messrs. Badham, Barthropp, Crisp, Biddell, Wotton, Williams, and Capron. The best horses are bred in the Woodbridge district. The earliest successful breeders were the late Mr. Catlin and the late Mr. Crisp.

Stallions for Agricultural Purposes.

Class I.—The competition amongst aged horses was very great, there being 28 entries. The first prize was awarded to Mr. G. D. Badham, Suffolk, for his noted Suffolk horse "Emperor," now 4 years old. This is a splendid horse, and hard to beat, though this was done when competing for the special prize: he girths 7 feet 8 inches. The second prize was awarded to Mr. Berridge of Ingarsby, Leicestershire, for his 3-years-old "Dishley black" horse, a descendant of the justly celebrated black breed established by the late Mr. Bakewell of Dishley, Leicestershire. This breed has been subsequently preserved by

the late Mr. Berridge of Frisby on the Creake, and his successors, for more than sixty years. Mr. Berridge's horse has a clear and most valuable pedigree of his class. Two others, shown by Mr. Crisp of Woodbridge and Mr. Wilson of Baylham Hall near Ipswich, were highly commended; and two shown by Messrs. Begbie of Lytham and Nightingale of Worsley were commended. These were very useful animals. Considering the great competition, this was by no means a good class.

Class II.—*Young Agricultural Stallions.*—There were 16 competitors. Among these Mr. Crisp, of Butley Abbey, received the first prize for his 2 years old Suffolk colt "Ploughboy," a fine style of horse. The second prize was awarded to Mr. Taylor, Peterborough, for his 2-years old Lincolnshire colt "Young England's Glory." This was a colt of great substance, promising to make a dray-horse. These colts were also both victorious for the special prizes under the same heading. "Emperor," a chesnut Suffolk, shown by Mr. Crisp, was highly commended, and Messrs. Robinson of Warrington and Wilson of Baylham Hall were commended for two other entries. This was rather a promising class.

Class III.—*Mares and Foals for Agricultural purposes.*—There were 16 entries. It was a useful but not a good class. The mares were wanting in the old square stamp of cart-horse; their frames were too long in the middle piece.

Class IV.—*Agricultural Fillies.*—Was a tolerably good class. Mr. Fisher's prize grey filly promised to make a good cart mare. The second prize filly was rather coarse. There were several other good animals in this class.

Dray-horses.

Class I.—The prize old horse in this class was a real specimen of a dray horse, large and lusty. The animals shown by Messrs. Baker, Spencer, and Robinson (Nos. 328, 333, and 337) were also very good, but wrongly placed, especially the two last; they should have been entered for the agricultural purpose prize. These classes are very intricate and conflicting. After all it is a matter of choice as to which class these heavy horses should compete in, and a similar difficulty meets the Judges. It should be borne in mind that a heavy dray-horse should be a "dray-horse," and those for agricultural purposes should be more active and symmetrical. Messrs. Spencer's grey horse girthed 8 feet 2 inches. There were 10 entries.

Class II., for young stallions calculated to produce dray-horses, is indeed a questionable class. Who can say at 2 years old what

they may ultimately turn to? Only three competitors made their appearance, and they were by no means a good lot.

Class III. for mares calculated to breed dray-horses is again an uncertain and unappreciated class by the public: only one entry was made, and the prize was withheld.

Class IV.—As another illustration of the intricacy and uselessness of these classes for young horses intended to turn out dray-horses, we have only to mention that there was not a single entry for the prize offered for 2-years old fillies.

Other Horses.

Class I.—*Thoroughbred Stallions for getting Hunters:* 12 entries.—The class generally was not so good as at Salisbury. Mr. Manfield, from Yorkshire, received the first prize for his horse "Spencer," now 6 years old. The second prize was awarded to "Canute," the property of Mr. Spence, also from Yorkshire. This was a close contest, as had been the case before, when the judgment was reversed. "Spencer" is a horse of considerable merit, and as good an animal as the Society can expect to have exhibited, under all the circumstances of exposure to wind and weather for four days in the show-yard; but he is not altogether the sort to be desired for general use. The others in this class were not of a kind to produce the "English hunter."

Class II.—*Stallions for producing Hackneys.*—This was a good class, and the lovers of the old "roadster" had several good nags to select from. The demand, however, for this style of horse has somewhat gone by. Some horses in this class were between the thoroughbred and roadster, and well calculated for producing weight-carrying hunters, but excluded from that class by their not being quite thoroughbred. Would it not be well to open a new class for this description of animal? The two roadster horses "Troubadour" and "Serenader," exhibited by Mr. Ridsdale, from Yorkshire, were, indeed, first-class animals of their kind—father and son. Sir Watkin W. Wynn, Bart., also exhibited an excellent animal, which, however, was not calculated for this class, neither could he be shown in Class I., not being thoroughbred. He is a stout, well-built horse, and quick in his paces.

Class III.—*Mares for breeding Hunters:* 15 entries.—These were not well selected, and scarcely what we expected to see in a hunting country like Cheshire. Perhaps the best specimen of a hunting brood-mare was (very properly) rejected for some slight but hereditary unsoundness. One or two good coaching mares were shown in this class for want of any proper class of their own

order. The prize mare belonging to Mr. Starkey, Chippenham, was a good-looking chesnut, about 10 years old.

Class IV.—*Mares for breeding Hackneys:* 5 entries.—This was a moderate class, devoid of character, and containing compounds of several breeds.

Sheep.

Early history.—The sheep is a native of most countries, but has been most cultivated in Europe, and especially in Great Britain. In each country they have taken their character from the wants and tastes of the people, but when left to themselves they represent every form of carcase and covering, fitting them for the particular climate and country in which they exist.

The indigenous breeds, such as the Dorset, Exmoor, Norfolk, Yorkshire, Wiltshire, Welsh, Scotch, &c., all had horns. These ancient breeds have now chiefly disappeared before the English plough, and have been replaced by breeds more in accordance with our improved agriculture, *namely*, the Leicester, South Down, and Long-woolled, the Shropshire, Exmoor, Cheviot, &c.

Leicesters.

The establishment of this breed of sheep dates from the successful career of the late Mr. Bakewell. The Leicester, as a lowland sheep, is without a rival, and has improved, if not given the principal value to the other long-woolled sheep.

Mr. Sanday, Holmpierrepont, has kindly furnished me with the original documents of the "Dishley Society," which have been handed down to him through Messrs. Bakewell, Stubbins, and Burgess, whom Mr. Sanday succeeded in the year 1847. These documents are both curious and interesting.

It appears that at the first meeting of those who were desirous of supporting Mr. Bakewell in his design of establishing a new breed of sheep at Dishley, the following resolutions were passed:—

"Resolution No. 1.—We, whose names are underwritten, agree to pay into the hands of Mr. Honeybourn (treasurer) the sum of 10 guineas each, in such sums, at such times, and for such purposes, as shall hereafter be agreed upon by the majority of the subscribers.—Wm. Walker, T. P. Stone, J. Bennet, J. Manning, J. Robinson, N. Stubbins, N. Buckley, R. Bakewell, F. White, J. Breedon, and S. Knowles.

"No. 2.—That Mr. Paget be President of the Society."

Three Crowns, Leicester, 5th January, 1790:—

"Resolution No. 4.—That secresy be kept by all members respecting the business of these meetings, except to absent members; and that any member quitting the Society keep secret, upon his honour, the transactions before he left it.

"No. 5.—Resolved, That no ram, the property of Mr. Bakewell, shall be let to, or in part used by, any ram-breeder but such as will engage not to let any rams at *fairs or markets.*

"No. 8.—That no member shall give his rams, at any season of the year, any other kind of food than green vegetables, hay, or straw.

"No. 13.—That no member shall let a ram, share or part of a ram, to any ram-breeder residing within 30 miles of Leicester, not being a member, who hired a ram of Mr. Bakewell last season, 1789.

"No. 27 (passed May 12th, 1794).—Resolved, That no ram shall be let to any ram-breeder at less than 40 guineas, supposing him to let 6 rams, or, if only 3 rams, 20 guineas."

Dishley, June 4th, 1794:—

"No. 30.—The members shall not show more than 24 rams to any person or company at one time."

Loughborough, June 4th, 1795:—

"No. 37.—Resolved, That no ram shall be let to members of the *Lincolnshire Society* in classes at less than 200 guineas.

"No. 41.—That no member shall sell any ewes in future, except to kill, at less than 10 guineas each."

Leicester, May 11th, 1796:—

"Resolved, That whoever deals with Mr. ——, of ——, shall pay to the Society 50 guineas. That not less than 100 guineas be taken from any of the persons whose names are hereafter written for their first contract for one ram, or, if two people join, not less than 200 guineas, after which the price to be 30 guineas for wether-getters."

Here follow the names of 57 breeders: amongst them are dukes, marquises, lords, and baronets.

By the reading of the 37th Rule it would appear that some jealousy was at hand with the Lincolnshire breeds. This is subsequently proved by a meeting held at Lincoln, July 13th, 1796, when it was unanimously agreed "that a society of breeders of the Dishley breed is necessary for the improvement of the breed, and for the benefit of the public."

"Resolved, That no one shall show any ram at a market, and that no one shall let more than 100 rams in one season.

"Thanks to Mr. Marfleet for this meeting. Adjourned to 9th August next. Signed by 10 Lincolnshire breeders, viz.:—Isaac Marfleet, Joseph Rogerson, Ph. Skipworth, Jno. Dudding, Wm. Cook, Rd. Ostler, Geo. Moody, Wm. Thorpe, Sam. Slater, and Benj. Codd."

As a proof of the high estimation in which the Dishley breed was held, I give an extract from an original letter:—

"Oastine Hall, Sept. 25th, 1797.

"Dear Sir,—Mr. Astley has determined to send (with your approbation) 50 ewes to Holmpierrepont, for the tupping of which, by the shearling and two shear, drawn equally to each, he will give you *four hundred guineas.* Your immediate answer by a special messenger to-morrow will oblige

"Yours, &c.,

"Thos. Tomalin.

"*To Mr. N. Stubbins.*"

Another instance may be given of the high celebrity of the Dishley or Bakewell breed of Leicester sheep in these early days for improvement. On the 16th November, 1793, Mr. Paget (the President of the Society) sold by public auction 200 Leicester ewes at sums varying from 16 to 62 guineas each! the 200 realized 2600 guineas!!

Amongst the members who constituted the "Dishley Society," the names of Messrs. Stubbins, Stone, and Buckley have been the most prominent in our time, together with many others, such as Creswell, Bennett, Pawlett, Spencer, Skipworth, Torr, Turner, Sanday, Bodley, Hewitt, Manning, &c. The most direct descendants from the old Bakewell stock at the present day are the flocks of Mr. Sanday, as handed down to him through Messrs. Burgess and Stubbins; of Mr. Pawlett, from the flock of the late Mr. Stone; of Mr. Creswell, from the old Holmpierrepont flock; of Mr. Umbers, from the Dishley flock, through the late Mr. Buckley; of Mr. Spencer, from the Cotgrave and other flocks; and of Mr. Torr, through the flock of Mr. Skipworth, which was also from the old Holmpierrepont flocks. In the year 1794 Mr. Creswell saved his first lot of ram-lambs, at which time he gave Mr. John Stone 300 guineas for the hire of a ram; then he gave Mr. Thomas Stone 250 guineas, and Mr. Stubbins 300 guineas, &c. &c. I turn now to the classes of this breed at the Chester Show.

Class I.—*Shearling Rams:* 38 entries.—This was collectively rather a good class; but a material difference was observable between the best and the worst. For truth of character and uniformity of quality the 8 rams exhibited by Mr. E. Pawlett took precedence. His first prize sheep was a good animal, as also his commended sheep, No. 394. Next to these came those of Mr. Creswell, who exhibited 6 rams. These were of his usual cast, with good size and fleece. His No. 420 sheep received the second prize. Mr. Borton's No. 404, and Lieut.-Col. Inges's No. 412, were each commended.

Class II.—*Aged Rams:* 23 competitors.—Here again we had the same exhibitors as in Class I., and many good animals were shown, especially the prize three-shear sheep exhibited by Mr. Pawlett—a true specimen of a Leicester, with more than common substance and usefulness. For the second prize there was a close contest between Mr. Spencer's two-shear, and Mr. Creswell's three-shear; nothing but the difference of age could have decided in this case in favour of Mr. Spencer. We notice that Mr. Creswell's sheep was highly commended. Mr. G. Turner, Mr. S. Umbers, Mr. Borton, and Mr. Pawlett, each had rams commended in this class, all of which

highly deserved this note of admiration on the part of the judges.

Class III.—*Shearling Ewes:* 9 entries.—The prize ewes were indeed good sheep, and it must have been a difficult point to decide upon the second.

The Society has now held 20 meetings, and offered 82 premiums for Leicester rams. Of these Mr. Pawlett has received 23.

Since Mr. Sanday commenced showing, about eight years ago, 34 prizes have been given, of which he has received 16, and Mr. Pawlett 13, leaving 5 only for all other competitors. But it may be remarked in justice to Mr. Sanday, that he did not compete at the Chelmsford and Chester Meetings.

Since the year 1847 I find that Mr. Sanday has received for rams and young ewes 35 prizes at the Society's meetings; twice (Lewes and Salisbury) he has won the whole; once, five out of six; once (Windsor) five out of nine; and two years he has not exhibited. I mention these facts to illustrate the value of purity of blood and long descent. At Lincoln, however, he had not a single prize awarded to him. Numbers of the Leicester breed of sheep are sent abroad.

South Downs.

These sheep, like the Leicesters, are destined for a particular purpose; they are unquestionably the best animals we have "as a working flock;" they feed more readily upon elevated situations and on the natural pastures and heaths of open lands: for the purpose of folding they are unrivalled. The country is much indebted to the early founders of this admirable class of sheep. The late Mr. Ellman was mainly instrumental in carrying on this great work of art. Subsequently others have given their aid; amongst whom Mr. Ellman's successors at Glynde; the late Mr. Grantham, Mr. Jonas Webb, the Duke of Richmond, Messrs. Rigden, Overman, Sainsbury, &c., are most familiar to our ear.

The Babraham Southdowns.—Mr. Webb has now been a breeder about 35 years; he commenced by purchasing the best ewes from the leading breeders in Sussex, regardless of expense, and then, like the celebrated Bakewell (with the Leicesters), set to work to remodel them into his own class and character of "Southdown," and has never since had a cross with any other breed. Mr. Webb commenced his career as an exhibitor at the Cambridge Meeting in 1840; he then, as a young hand, exhibited stock ewes and shearling ewes, for which he received both the first prizes; experience has since taught him that the fat-

tening of ewe stock for exhibition is a losing game, and he has exhibited rams only: I need scarcely record his success, it having been almost invariable. Experience has also shown him the folly of over-fattening aged rams for exhibition, and he has latterly as a rule shown only shearling rams, and these to perfection. At the great "International Exhibition" of France in 1856 Mr. Webb exhibited his shearling rams and obtained the prizes. The next year he exhibited both shearling and aged rams, and gained both the first prizes. Space will not admit of further details.

The Goodwood flock of Southdowns.—A flock of Southdown sheep has been kept at Goodwood in the county of Sussex for upwards of 100 years. In the year 1825 the present Duke of Richmond turned his attention more particularly to the improvement of the flock, and with this view purchased some of the best animals obtainable. Since the year 1830 sheep selected from this flock have gained 8 gold and 31 silver medals, at the Smithfield Club Shows; since the year 1840, 17 prizes, at the Meetings of the Royal Agricultural Society; and since the year 1847, 17 prizes at the Sussex County Shows. The animals that gained these prizes were not only bred at Goodwood, but were also nearly all descended from animals bred there. The flock numbers upwards of 2000, exclusive of 1000 lambs which are annually bred. A large proportion that are drafted yearly are sold for breeding purposes, and much inquired for by foreigners as well as English breeders. A considerable number have been purchased to go to France, Prussia, Russia, &c.

Mr. Rigden, of Hove, Messrs. Sainsbury, Overman, and others are also noted as Southdown breeders.

The Southdowns are chiefly bred in the counties of Sussex, Surrey, Hants, Wilts, and Dorset; there are also several eminent breeders in Cambridgeshire, Norfolk, and Suffolk; in fact but few English counties are without them. Many flocks are also kept in Ireland and Scotland.

Class I.—*Shearling Rams:* 23 entries.—The prizes in this class were awarded to the flocks of Mr. Rigden and the Duke of Richmond; they both exhibited some fine specimens, Mr. Rigden being the champion. Lord Walsingham also exhibited some good shearlings.

Class II.—*Aged Rams:* 16 entries.—Here again Mr. Rigden received the first prize for his three-shear ram, a superior animal; the Duke of Richmond the second, for his 2 years-old ram; Lord Walsingham's 2 years-old, No. 491, was named as

the reserved number, next best. This class was less important than in some former years.

CLASS III.—*Shearling Ewes:* 14 entries.—Singular to relate, here again the names of Mr. Rigden and the Duke of Richmond were placed as in the two former classes. The Duke of Marlborough's pen, No. 504, was highly commended. There were some beautiful shearling ewes in this class, which have rarely if ever been surpassed.

The general exhibition of Southdowns at Chester was meagre in comparison with some former shows. The entries were 402 at Salisbury and 302 at Chester.

LONG-WOOLLED SHEEP.

This class embraces the Lincolns and Cotswolds, together with other breeds of similar cast and character. The long-wools of the eastern and marshy districts of England were among the earliest strong-natured sheep of our island: their coarse bone and flesh and strong staple of wool, collectively made them a hardy and valuable race for the endurance of a wet and wintry life upon their native plains.

The old Teeswater and Romney Marsh sheep were much of the same family, separated only by distance and management. These respective breeds have been since remodelled—and with this the Leicester sheep has had much to do.

Amongst the earliest attempts to remodel the old long-woolled Lincoln breed was the formation of a Society at Lincoln in July, 1796.

At this Meeting, presided over by Mr. Marfleet, 10 leading breeders agreed "That such a society was necessary for the improvement of the breed and for the benefit of the public." There were still some members of the "old school" left to perpetuate the "old sort" of *real* long-wools, among whom the late Mr. Israel Brice of Riseby and the late Mr. Paul Walesbury were conspicuous.

The introduction of the "Dishley breed" among these extremely coarse animals quickly told upon the old flocks, and in fact created a new middle-class animal. It is to this admixture that Lincolnshire is so much indebted for the splendid "lamb-hogs," of which full 60,000 are not unfrequently seen at Lincoln April fair. The principal hog-breeders are Messrs. Battersby, Howard, Slaters, Dudding, Pell, Reyworth, Mawer, Clarkes, &c. I have known 14 months-old lamb-hogs slaughtered at Lincoln fair, 30 together, averaging 35 lbs. per quarter; and I have known 100 together clip 14 lbs. each of washed wool.

The leading ram-breeders of the present day are the Messrs.

Clarkes, Kirkham, Casswell, Richardson, Chaplin, Gilliott, Torr, Abraham, Lynn, &c. At the North and South Lincolnshire Meeting at Grantham, 20th July, 1858, Mr. Charles Clarke, of Scopwick, Lincoln, was an unrivalled winner of the Lincolnshire sheep ram prizes. Mr. Clarke preferred exhibiting his rams for local honours amongst his home customers to taking them to the Chester Meeting; but we had thus the benefit of his judgment as one of the Judges of the long-woolled breeds. It is to be regretted that the Lincolns do not enter into competition with the Cotswolds.

The Cotswolds are of ancient date, their original office having been that of enduring the climate of the wild and then uncultivated Cotswold hills. They have since been remodelled by successive breeders, until they have now attained a very high position amongst the "established breeds." They are chiefly bred in the county of Gloucester and surrounding districts, and are not unfrequently called "Gloucesters," but this name has now become merged into the one title of Cotswolds.

They are raised of enormous size and weight, proving their possession of a good constitution and aptitude to fatten. As a remodelled breed they are much indebted to the Leicester blood, retaining, however, their original "Cotswold" characteristics of size, fleece, and lean meat. The other original long-woolled breeds, such as the Teeswater, Kent sheep, &c., have now become nearly extinct by the repeated use of Leicester rams.

The exhibition of long-woolled sheep at the Lincoln Meeting was by far the largest we have yet had. This, in the land of the long-woolled Lincolns, produced 192 animals, while at the Chester Meeting the classes were confined to 136 Cotswolds.

Class I.—*Shearling Rams:* 44 entries! which, numerous as they may appear, were all from 12 breeders in the county of Gloucester.—Collectively this was an imposing class. The first and second prizes were awarded to Mr. William Lane, Broadfield, Northleach. There were five other sheep noticed by the Judges—2 highly commended and 3 commended.

Class II.—*Aged Rams:* 17 entries; shown by Gloucestershire breeders. This was considered a good class, but by no means so good as the young sheep. The first prize was awarded to Mr. William Hewer, Northleach, for his 2 years-old sheep; the second to Mr. Garne, near Northleach, for his 3 years-old sheep. Three others were commended by the Judges.

Class III.—*Shearling Ewes:* 15 entries. This was a remarkable class, and said by the Cotswold and other breeders to excel that of any former show, which augurs well for the

rising generation. Mr. Hewer here again carried off the first prize, Mr. Lane being a close second; four other pens were commended by the Judges. The class throughout elicited high approbation from the public. The leading breeders of this eminent class of sheep are Messrs. W. Hewer, W. Lane, R. Garne, E. Handy, E. Ruck, T. B. Brown, W. Smith, J. K. Tombs, T. Porter, W. Cothier, G. Fletcher, T. Walker, &c. The name of the late Mr. C. Large must not be omitted, as he was mainly instrumental in the early improvement of these sheep. When shown as hogs at the local fairs they weigh from 22 to 26 lbs. per quarter and carry from 9 to 10 lbs. of wool each. The Emperor of the French has expressed his "delight" at the quality of their mutton. These sheep have been much sought after for crossing other breeds. Rams have been known to weigh from 70 to 80 lbs. per quarter; ewes have also been killed weighing from 60 to 70 lbs. per quarter. It is the practice of the ram-breeders to *sell* their shearling rams, every year, about the month of August. Mr. Cothier, Middle Aston, Oxon, auctioneer, has sold upwards of 1000 rams for these breeders in one year. There is an export trade to France, America, Australia, &c., which is increasing.

SHEEP.

Number of the Class.		Number of Entries.	Average Age of Prize Animals.		Average Girth of Prize Animals.	
			Yrs.	Months.	Ft.	Inches.
Leicesters.						
Shearling Rams	1	38	1	4	4	9½
Aged Rams	2	23	3 4 and 2	3¼	5	6
Shearling Ewes	3	9	1	3½	4	0
		70				
South Downs.						
Shearling Rams	1	23	1	4	4	3
Aged Rams	2	16	3 4 and 2	4	4	9½
Shearling Ewes	3	14	1	4	4	1
		53				
Long-woolled Sheep.						
Shearling Rams	1	44	1	3¼	5	2¼
Aged Rams	2	17	2 4 and 3	4	5	9
Shearling Ewes	3	15	1	4	4	11
		76				

Other Short-woolled Breeds, not being Southdowns.

The wording of this class conveys the impression that there are many "other short-woolled breeds," which is correct to a certain extent. They number amongst them the Hampshire, Wiltshire, and Shropshire Downs, and even Cheviots. But the Hampshire and Shropshire breeds are the only breeds which really come into competition.

The Hampshire sheep are clearly descended from an original hardy race peculiar to the county, possessing in early days the same bony characteristics as the long-woolled Lincolns. They have partaken of the improvements of other breeds; but their strength of constitution and size have been retained as characteristic of the animal, less attempt having been made to imitate the beauty and high proof of the Southdown. These sheep, as seen in numbers upon their native soil, are bold rent-paying animals. As show sheep they have not reached the requisite uniformity of cast and quality.

The Shropshire sheep also date their origin from an old county breed—the Morfe Common sheep, which ancient history describes as having "thick coats, and peckled faces." The Society's meeting at Shrewsbury in 1845 first introduced this breed to public notice, and sales of rams were then made at from 5*l.* to 7*l.* each, and of ewes at about 2*l.* each. Then followed the special classes opened for them at the Gloucester Meeting in 1853. They had now obtained a great name for robustness of form and wool, as a dark-faced, short-woolled sheep. A great stimulus was thus given to the trade in these sheep, and large prices were realised. On some occasions rams reached an average of 20*l.* each, and ewes made 5*l.* to 10*l.* each. In one instance 78*l.* 15*s.* was realised for a pen of five ewes. Their average weight of wool over a whole flock is from 6 to 7 lbs. per fleece. One of the oldest flocks, from which many of the best sheep are descended, was that of the late Mr. Mines, of Berrington, near Shrewsbury, established upwards of ninety years ago. These were originally a large "peckled-faced" breed, and then made 25 lbs. per quarter at two years old without artificial food. The fancy of breeders has since turned more to self-coloured faces, the "peckled-faced" ones are rejected as breeding sheep, and by degrees, with proper selection, they have become uniformly of a grey colour; some families, however, being much darker. Attempts to improve the breed by crossing have proved a failure. With the Southdown cross the result has been a loss of size and wool, and with the long-woolled sheep there has been a loss of character in coat and quality. Shropshire Downs appear well adapted

to the midland counties, and they are being tried in other localities also: some have been sent to Ireland. Professor Wilson gives an interesting account of these sheep in his paper 'On the Various Breeds of Sheep in Great Britain' (Royal Agricultural Society's Journal, vol. xvi.). Mr. Milward, in his report 'On the Exhibition of Live Stock at Gloucester' (vol. xiv. p. 458), states:—"The new class of Shropshire Downs was very successful; it is to be hoped that the Society will recognise them as a distinct breed." At the Gloucester meeting this new class contained 121 specimens; at Chester, in 1858, they reached 184; and of an improved character, showing more uniformity as a county breed. The most popular breeders of these sheep are W. O. Foster, Esq., M.P., Kinver Hall, Stourbridge; E. Holland, Esq., M.P., Dumbleton Hall, Evesham; G. Adney, of Harley, Much Wenlock; H. Smith, jun., Sutton Maddock, Salop; James and Edward Crane, Shrawardine, Shrewsbury; Mrs. Baker, Grindon, Atherstone, &c.

The Cheviots, although classed as a short-woolled breed, cannot enter into competition with the others, being in fact the representatives of a mountain district, and not of a highly cultivated country.

We turn now to the classes shown at Chester:—

Class I.—*Shearling Rams:* 61 entries!—These were composed of Hampshire, Oxfordshire, Shropshire, West-country Downs, and Cheviots. It was indeed a task for the Judges to compare 61 animals of different breeds, breed against breed, size against symmetry, and both against the lean but respectable mountain Cheviot.

The first and second prizes, as also a high commendation for a third ram, were awarded to Mr. William Humfrey, of Oak Ash, near Wantage, Berks, for his three shearling rams, numbered respectively 647, 650, and 651. They were entered by Mr. Humfrey as West-country Downs with brown faces. The other commendations in this class fell upon Messrs. Crane's Shropshire Downs, Mr. W. O. Foster's Shropshire Downs, Mr. Bryan's Oxfordshire Down, and Mr. Humfrey's West-country Down. The several girths of these shearling rams were as follows:—

1st prize,	No. 647,	4	feet	6	inches.
2nd ,,	No. 650,	4	,,	1	,,
,, ,,	No. 651,	4	,,	1	,,
,, ,,	No. 622,	4	,,	8	,,
,, ,,	No. 625,	4	,,	6	,,
,, ,,	No. 640,	4	,,	4	,,
,, ,,	No. 648,	4	,,	3	,,

Class II.—*Aged Rams:* 27 entries.—Here, again, we had representatives of all the above breeds, forming a most inter-

esting "collection" of animals. The first prize was awarded to Mrs. Baker, of Grendon, near Atherstone, for a 2-year old Shropshire sheep — a magnificent animal. The second prize was awarded to Mr. G. Adney, of Harley, for his 4-year old Shropshire Down. Mr. Bryan's 4-year old Oxfordshire Down, and Mr. Humfrey's 4-years old West-country Down, were highly commended. There were also four aged rams commended, viz. :—Mr. Brown's Hampshire Down, Mr. Kettle's Shropshire Down, and two of Mr. Humfrey's West-country Downs. Amongst so many conflicting breeds it must have been difficult indeed to decide, both as regards the comparative breeds and the specimens of each.

Class III.—*Shearling Ewes:* 22 entries.—This was a good class. Mr. Humfrey was awarded the first prize, for his West-country Down ewes; Mr. Coles, of Wiltshire, the second, for his improved Hampshire Downs. Mr. Crane's Shropshire ewes and Mr. Humfrey's were highly commended; and the Shropshires of Messrs. Crane and Mr. Holland were commended. This competition of "other short-woolled sheep, not being Southdowns," requires the consideration of the Council as to whether they can be separated into distinct classes of established breeds.

Pigs.

These were shown in good numbers, there being collectively 168 pigs in the yard, viz., 69 of the large breed, and 99 of the small breed. The majority of the entries were of the small breed. The large pigs formed a curious spectacle; their length, height, and unwieldy frames were the wonder of all. Those of the small breed, although excessively fat, were of more ordinary and familiar proportions.

The entries of white pigs this year preponderated over those of the Berks and Essex blacks.

The breed of large white pigs has its origin in the north of England: Yorkshire, Lincolnshire, and Lancashire have long been celebrated for them as bacon hogs. This class of animal has been remodelled into better shape by a cross with the small breed. The prize boar in Class I. was an extraordinary animal; he actually weighed at the Chester Show $10\frac{1}{4}$ cwt., or 82 stone; and on inquiry I learned that his dam, the prize sow of the large breed at Carlisle, weighed, when shown there, at the age of 2 years and 1 month, 84 stone. She was sold for 45 guineas. This breed is called the "Lancashire improved." When 10 months old they weigh nearly 30 stone, and at 2 years old from 50 upwards, or, in the

words of the owner, "What you please, Sir." I guess they are *rather* large consumers. The small breed has long been a highly cultivated race of animal, and much pains have been bestowed upon them. The Smithfield Club Show has done wonders in bringing out good specimens of this very useful class. Even some twenty-five years since, Lord Harborough, at Stapleford Park, Leicestershire, used to exhibit splendid young pigs at agricultural meetings. On inquiry I find that they were bred from a Neapolitan boar and a Chinese sow. They had great aptitude for fattening, light offal, and scarcely any hair; in colour usually "sheeted" black and white. At 20 weeks old many of them have weighed 10 and 11 stone, and several have been suffocated with over-feeding. These pigs, from their small and compact forms, were not popular amongst the tenant-farmers; but for porkers, in connexion with dairy farms or gentlemen's houses, they were excellent. The Earl of Radnor and the Prince Consort have each exhibited some magnificent pigs of the small breed at the Smithfield Club shows: these are of a white colour. Earl Radnor's are designated the "Coleshill pigs," descended from the stock of Mr. E. W. Moore's father, who had the breed nearly fifty years ago. Mr. S. Wiley, of Brandsby, Yorkshire, has also been long celebrated for his white pigs of the small breed. Mr. Wiley informs me that he had the breed "full fifty years ago," and that about the year 1817 he had from the celebrated Mr. Robert Colling, of Barmpton, a sow from which he bred a great number of first-class pigs. Mr. Wiley has retained a true pedigree of his breed from this early date. I need scarcely say they are beautiful animals—their success at the Chester and previous meetings illustrates it.

The Fisher Hobbs breed of Essex blacks is another instance of the high position gained by a small breed. Comment upon this breed is quite unnecessary, their success having been unrivalled. Mr. Hobbs has an immense sale for his "black beauties." Mr. Crisp, of Butley Abbey, Suffolk, and Colonel Towneley, of Towneley Park, have also beautiful pigs of the small breed; and other popular names might be recorded.

Class I.—*Boars of a large breed:* 19 entries.—The North-country large white pigs showed to great advantage at Chester. The first prize was awarded to Mr. J. Harrison, jun., of Heaton Norris, Stockport. The second prize was gained by Mr. Joseph Gill, Silsden, York. They were immense animals. Another of Mr. Harrison's was highly commended; and Mr. Richardson, Hibaldstow, Kirton Lindsay, had a 4 years and 11 months old Lincoln pig commended.

Class II.—*Boars of a small breed:* 29 entries.—These were

chiefly white. The first prize was won by a 2-year old small white boar of Mr. Hill's, Back Hall, Chester; the second by Mr. Brown, Brewry House, Cumberland, for his 3-year old Cumberland white pig. Mr. J. Harrison's white pig was highly commended. The whole class was commended, with the exception of Nos. 722 and 748.

CLASS III.—*Sows of a large breed:* 28 entries.—This was collectively a very good class. There were a few Berkshire and a few cross-bred in this class, but they appeared quite out of place in comparison with the large white pigs from the north. The first prize was gained by Mr. Barker, of Leeds, for his 2-year old sow; the second by Mr. Wilkinson, Roundhay, near Leeds. Mr. Wilkinson's old sow, No. 773, was also specially commended by the Judges. Mr. Wainman's 3½-year old sow, and Mr. Tuley's 4-year old sow, were each highly commended: these were from the neighbourhood of York. Four others were commended.

CLASS IV.—*Sows of a small breed:* 35 entries.—As a proof of the excellence of this class, there were 10 "placed" by the Judges; and the whole were commended "as an extraordinary class." To gain a prize in such a class must have been meritorious indeed. I may mention that I witnessed (as steward of this department) no less than eight symmetrical animals paraded before the Judges for examination, and they remarked to me that "they knew not where to begin." After much deliberation the first prize was awarded to a 14 months-old sow, the property of Colonel Townley; and the second to Mr. Harrison, of Everton, near Liverpool, for his 1 year and 11 months old sow. Mr. Crisp, of Butley Abbey, Suffolk, was specially commended; and a second of his was highly commended. Colonel Townley had a second sow highly commended. Five others were commended. The whole of the above 10 sows were of the white breed. There were but 5 of the black breed in the class, and one of the Oxfordshire.

CLASS V.—*Pens of three Breeding Sows of the large breed:* 5 entries.—These included 2 pens of Berkshires, 2 black and white, and one of white pigs. Here the coloured pigs had it all their own way. It appears evident that the long-breed pigs cannot make a respectable show at this age. Those exhibited were scarcely "pigs of a large breed," but crosses between the large and small breeds. For practical, rent-paying purposes, this combination of the two extremes appears to me the better breed. The prize was awarded to Mr. E. Bowly, of Siddington, Cirencester, for his pen of 8 months old improved Berkshire pigs. The Judges

commended a pen of pure Berkshires, shown by Mr. Sadler, Cricklade, Wilts.

Class VI.—*Pens of three Sow Pigs of a small breed:* 11 entries.—This was a good class—10 pens of white and 1 of the Oxfordshire breed. Mr. Wiley, of Brandsby, York, carried off the first prize with a beautiful pen of his celebrated "whites." One pen shown by Mr. Watson, Bolton Park, Cumberland, were specially commended; and another highly commended. A pen exhibited by the Hon. Colonel Pennant, Penrhyn Castle, Bangor, were commended.

SPECIAL PRIZES

Given by the Chester Local Committee.

The district premiums at the Chester Meeting certainly brought before us objects of much local interest; the more so from the Principality having been the seat of some of our original breeds of cattle. Howell the Good describes some of the Welsh cattle in the tenth century as being "white with red ears," resembling the wild cattle of Chillingham Castle. These were preserved in the parks of the nobles. The same record mentions also the "dark or brown coloured breed" which now exists, and which is general throughout the Principality. These are of the "middlehorn" class already alluded to. They are stunted in their growth chiefly from the scanty food which their mountain walks produce, but they carry with them many of the characteristics of the Hereford, Devon, and Sussex cattle. Amongst them we have in South Wales the Pembrokes, Glamorgans, Monmouths, &c. The steers of these breeds have long commanded a ready sale in the midland counties, and when fed for the London market are fully appreciated by the butcher.

North Wales, considered as a cattle country, is divided into two districts: the first includes Anglesey, Carnarvon, and Merioneth; the second, Denbigh, Flint, and Montgomery: the latter being celebrated for its dairy produce, whilst in the former the rearing of cattle is almost exclusively attended to. It is impossible to give correctly the numbers of cattle annually sent from North and South Wales to the English counties. I find that in 1855 22,000, and in 1857 25,000, passed through the Chester station; and we may safely say that an additional 5000 would go by the road. These oxen or runts are principally grazed in Leicestershire, Northamptonshire, and Warwickshire. The small (but best) heifers go to the eastern counties, Kent, &c. Nothing

but spirited attention is required to make this branch of agriculture an important and profitable pursuit; all that is needed being that farmers should be more careful in the selection of their breeding stock, and keep their best heifers to breed from instead of selling them into the eastern markets. Like the Scots, they thrive where large English beasts would starve. The Smithfield Club has already recognised them as an established breed, worthy of a place in the Club's prize-sheet.

CATTLE.

CLASS I.—*Aged Bulls, not exceeding* 6 *years old:* 27 entries. —There were 8 animals entered in this class alone, and 19 more entries from the Society's classes, viz., 16 from Class I. for short-horns, 2 from Class I. for Devons, and 1 from the class for other breeds. I need scarcely remark that this was a complicated affair, involving very unpleasant work for the Judges, who had to perambulate these several classes to find the entries, and then walk to and fro to compare the animals. The same duty devolved upon them in the sheep and pig classes, and they were all glad when their unpleasant duties were at an end.

The first prize was awarded to Mr. Bradburne, Lichfield, for his short-horn bull shown in Class I. This bull was commended in his own class. The second prize was given to Mr. Price, Feathersham, Wolverhampton, for his short-horn bull shown in Class I. The bulls shown by Mr. Waller, jun., Mellor, Stockport, and Mr. R. Barton, Caldy Manor, Birkenhead, were commended. These had been entered only in the special class.

CLASS II.—*Young Bulls.*—Three animals were exhibited in this class: there were also 12 bulls entered, which were shown in the short-horn Class II., and one bull shown in the Devon Class II. The first prize was awarded to Colonel Pennant for his young short-horn bull, No. 32, shown in the Society's Class II. This bull was also highly commended in his own class. The second prize was awarded to the Hon. and Rev. J. H. Noel Hill, of Berrington, Shrewsbury, for a short-horn bull exhibited in the Society's Class II. There were no commendations in the special class.

CLASS III.—*Pairs of Cows for Dairy purposes.*—10 pairs were exhibited in this class. There was one entry from the Society's Class IV. (Herefords), and one from the class for other breeds. These prizes were taken by some very excellent short-horns. Mr. Ambler, of Watkinson Hall Farm, Halifax, received the first, and Mr. Stratton, of Broadhinton, Wilts, the second: the third was awarded to Mr. Churton, of Barrel Well House, near

Chester, for a pair of cross-bred dairy cows, breeder unknown. Mr. Palin's pair of Yorkshire cows were commended. The whole of the successful dairy cows were of the short-horn breed. This was a good useful class for their purpose.

Class IV.—*Pairs of Heifers under 3 years old.*—6 pairs were entered: 2 were exhibited in the class; 2 were shown in the short-horn Class III.; and one pair in the Devon Class V. The first prize was awarded to Mr. Price, Featherstone; the second to Colonel Pennant, for his pair of heifers shown in the special class; the third was awarded to Mr. Dawson, Gronant, Rhyl, Flint.

Class V.—*Pairs of yearling Heifers:* 7 entries.—5 were exhibited in the class; one in the Short-horn Class VI.; and one (polled Norfolks), in Class V., for "other breeds." The first prize awarded to Mr. Price, of Featherstone, the second to Colonel Pennant, for his pair of short-horns shown in this class.

Welsh Breeds.

Class I.—*Bulls above 2 and under 3 years old:* 4 entries.—Both prizes were very justly awarded to Colonel Pennant for two 2 years-old bulls. They were useful animals.

Class II.—*Bulls of any age:* 5 entries.—The first prize was awarded to Colonel Pennant; the second to Sir R. B. W. Bulkeley, M.P., Barron Hill, Beaumaris, Isle of Anglesey.

Class III.—*Heifers or Cows in calf or in milk above 2 years old:* 9 entries.—In this class Sir R. Bulkeley carried off the first prize, and Colonel Pennant the second and third. Two others in this class were highly commended.

Class IV.—*Yearling Heifers.*—In this class Colonel Pennant exhibited three beautiful heifers, gaining first, second, and third prizes.

Class V.—*Two-year old Heifers.*—Here, again, Colonel Pennant carried off all three prizes. The animal which won the first prize was the true type of a Welsh heifer, and well worthy to be studied as a model beast for the Principality.

The exhibition of Welsh cattle as a whole was a creditable display of the breed, thanks to the gallant Colonel Pennant for his marked enterprise in thus bringing them into public notice. For their respective climates they would be difficult to replace with stock more suitable or more profitable. This display may be the means of a strong move in the right direction. I quote the valuable opinion of Mr. Hugh Watson, of Keillor:—"I have no doubt that either our West or North Highland cattle might be profitably introduced into the mountainous districts of Wales;

and on the lower pastures, the polled Angus or Galloway breeds. They are both of fine quality and rent-paying animals on middling pastures; but perhaps the first step should be to improve the pastures by surface-draining when required—and by liming and burning where the herbage is coarse."

Other Established Breeds.

Class I.—*Aged Bulls.*—The prize was awarded to the Earl of Southesk, Kinnaird Castle, for his polled Angus bull. This was an animal of great merit.

Class II.—*Young Bulls.*—The prize was awarded to Lady Pigot, Chippenham Park, Cambridgeshire, for a very beautiful West Highland bull.

Agricultural Horses.

Class I.—*Stallions above* 2 *years old:* 28 entries.—5 of these were exhibited in this special class alone, 21 others were shown for the Society's prizes in Class I. for agricultural horses, and 2 in Class I. for dray-horses. These special prizes thus brought together the winners of the Society's prizes in honourable competition with others that were entered for special prizes alone.

The noted prize horse "Nonpareil," the property of the Messrs. E. and M. Read, of Beamish Burn, near Chester-le-Street, Durham, again proved triumphant as the "champion horse in the yard." He is a splendid specimen of the bay cart-horse; he was got by Mr. Bryan's noted prize horse "Samson." He was considered to be a perfect animal. The prize Suffolk horses had no chance with him. The second prize was awarded to a Lincolnshire horse exhibited by Colonel Pennant. He also beat the Suffolks.

Class II.—*Stallions foaled in the year* 1856: 12 entries; 4 shown in this class alone, and 8 in the Society's Class II.—These prizes were awarded to the same horses that received the Society's prizes in Class II. for agricultural horses, viz.,—First prize to Mr. Crisp, for his Suffolk colt; second to Mr. Taylor, for his Lincolnshire bay colt.

Class III.—*Pairs of Horses for Agricultural Purposes:* 13 pairs entered.—They formed an interesting feature in the local exhibition. Both prizes were awarded to Cheshire teams; a pair of bays and a pair of greys.

Class V.—*Yearling Colts or Fillies:* 8 entries.—This prize was won by a Cheshire exhibitor: another was commended.

Dray-horses.

Class I.—*Aged Stallions:* 3 entries.—The prize was awarded to Mr. Hughes, Woodfarm, Shorley, Flint, for his 8 years-old bay horse "Young Marquis."

Other Horses.

Class I.—*Thoroughbred Stallions for getting Hunters:* 14 entries.—Mr. Spence received the first prize with his chesnut horse "Canute," which was second for the Society's prize. The prize horse "Spencer" was not entered for the special prizes. The second prize was awarded to Mr. James Baker, Atherstone, for his 10 years-old chesnut horse "Comeaway."

Class II.—*Mountain Pony Stallions not exceeding* 13 *hands:* 8 entries.—The prize was awarded to Mr. Moffat, Crosby-on-Eden, Carlisle, for his thick and strong dark bay pony "Highland Laddie," 6 years old; the second to Sir W. W. Wynn, of Wynnstay. This class was highly commended.

Class III.—*Mountain Pony Mares not exceeding* 13 *hands:* 11 entries.—5 of these were noticed by the Judges. Mr. Rea, of Monaughty, Radnor, received the first prize for an excellent bay pony, which was long and low, with apparently good action —a valuable animal. The second prize pony had less merit; it was the property of Mr. Roberts, Bodidris, Denbigh. This was a tolerably good class, but by no means up to public expectation.

Class IV.—*Stallions for improving the breed of Welsh Ponies:* 5 entries; 3 shown in the class, and 2 in Class II. (stallions for getting hackneys).—First prize awarded to Sir P. Mostyn's horse, No. 944; second to Mr. Edwards, Orton, Wolverhampton, shown in Society's Class II. Mr. Risdale's horse "Troubadour" was also entered, but, although greatly admired for getting "hackneys," was thought too large for improving the breed of ponies—a proper decision.

Class V.—*Mare-Ponies not exceeding* 14 *hands:* 7 entries.—This class can scarcely be designated a pony class; 14 hands is the size of a cob or galloway. Sir P. Mostyn, Bart., received the first prize, and Mr. Wilcoxon, Upton, Chester, the second.

Class VI.—*Two years-old for Hunting Purposes:* 5 entries. —The prize was awarded to Mr. Heath, Heffersham Grange, Northwich.

Class VII.—*Yearlings for Hunting Purposes :* 9 entries.—Prize awarded to Mr. Parker, Aldford, Chester; Mr. Fawkes's, Outertown, Dumfries, was commended.

Sheep.

The local committee, with a view to bring out the sheep of the district, offered liberal premiums for the local breeds, especially the Welsh and Shropshire. The latter have already been alluded to under the head of the Society's class for "other

short-woolled breeds." The Welsh call for a few remarks from their hitherto secluded position. They have been described as an aboriginal race, enjoying their freedom over the mountain ranges. An early writer upon the mountain breeds of Wales says of them:—

"Some are horned, others polled; some are nearly white, others of every intermediate hue between a dirty white and a perfect black. They all, however, agree in the following particulars:—The head is small; the neck long, erect, and delicate; the forequarters light, with narrow breast and shoulders; the sides flat, the back and loins narrow, the legs slight and long; the animals possessing considerable agility and an unquiet habit, so as to render them most annoyingly troublesome when attempted to be kept in the small enclosures of the vale. The fleece weighs about 2½ lbs."

Here we have a pure aboriginal animal before us, untouched, as are their pastures, by the hand of the husbandman, and exactly what "ought not to be." The question now arises, Can this state of things be improved? if so, how, and by what means?

Much has been written on animals adapting themselves to climate and hardships: surely these hitherto neglected breeds may be *assisted* in all that relates to a mountain life. If we turn to Scotland we find that the mountain race of sheep has been attended to in full ratio with other breeds, for, while they have their hardy black-faced sheep even to the summit of their loftiest mountains, we find them cultivating the hardy Cheviot at the middle altitude; and even up to some 400 or 500 feet they cultivate the Leicester. These are instructive examples for the Principality. Some fifty years since the sheep-farming of the mountains of Scotland was merely a nominal affair for both sheep and shepherds; it is now one of the staple returns of the northern counties. In reply to my inquiries, Mr. Hugh Watson, of Keillor, Cupar-Angus (one of the Judges for mountain sheep), whose celebrity as a breeder is so well known, writes thus:—

"In Classes I. and II., for Welsh mountain sheep, at Chester, the specimens exhibited were not worth cultivating. Their quality of mutton is said to be fine-grained and high-flavoured, which must be the effect of the herbs they feed upon, for the animal itself is ill-shaped, and must be hard to feed. They never can be made *rent-paying* animals. Could they not be supplanted by Southdowns from the poorest Sussex Downs, where they feed on furze and benty grass, and go far to seek their sustenance; or by the black-faced mountain breed of Scotland, that feed on the highest elevations of that country, and yield very delicate and high-flavoured mutton, and are twice the size of the Welsh mountain sheep? Where there is herbage sufficient to maintain them (which is not the case on the highest mountains in Scotland), the Cheviot sheep are a fine race, with mutton of first-rate quality and valuable wool; they are found in the greatest perfection on the green Cheviot range of hills in the south of Scotland, near the English border; and are now equally thriving on the pastures of Sutherland, Caithness, and Inverness-shires, but not on the most elevated mountains, these being occupied by the Scotch black-faced mountain sheep, a race well adapted for their wild range.

"It may be that in the present unimproved state of the mountain pastures in Wales no breed of sheep can be brought to any degree of perfection upon them. If it is so, the first step by the landlords should be to improve the pastures, by introducing, wherever they will take root, the seeds of various natural grasses, and plants such as the dwarf furze; also by draining where it is boggy, burning where the herbage is coarse and benty, and liming where required. These are improvements which have paid well on many mountainous districts of Scotland, and have changed the breeds of stock, now kept profitably where they would have formerly starved and become stunted, like the Welsh mountain sheep."

The Welsh sheep exhibited at the Chester Meeting were from the counties of Carnarvon, Radnor, Denbigh, and Merioneth. None were sent from the Isle of Anglesey.

CLASS I.—*Welsh Mountain Rams of any age:* 10 entries.—The first prize was awarded to Colonel Pennant, for an improved Welsh ram, which had signs of a dash of Cheviot about him; the second was awarded to Mr. Roberts, Llarsaman, Denbigh. This animal was unshorn, and had all the characteristics of a real mountaineer.

CLASS II.—*Mountain Ewes, any age, pens of five:* 7 entries.—The prize ewes showed a cross of the Cheviot. They were the property of Mr. Roberts, Bodidres, Denbigh. The second and third prize ewes were shown by Mr. Mynors, Evancoyd, Radnor. These pens were of a grey or brown-faced cast, showing signs of the Down blood, and had thick-set fine wool. The others were of a moderate description.

CLASS III.—*Shropshire Downs; Shearling Rams:* 50 entries! —8 animals were exhibited in this class alone, and 42 others competed in the Society's Class I. for shearling rams of a short-woolled breed, not being Southdowns. Mr. W. O. Foster, Kinver Hill, Stourbridge, received the first prize for his shearling, which girthed 4 feet 4 inches. The second prize was awarded to Messrs. J. & E. Crane, of Shrawardine, Shrewsbury. Their sheep No. 625 was also commended.

CLASS IV.—*Rams of any age:* 19 entries; 2 shown in this class, and 17 in the Society's Class II.—The first prize was awarded to the beautiful first prize sheep in the Society's Class II., the property of Mrs. Baker, Grendon, Atherstone. The second was given to Mr. G. Adney, of Harley, Much Wenlock, No. 659, and his No. 660 was highly commended. By this award the Judges reversed the position of Mr. Adney's two rams, the Judges of the Society's class having placed No. 660 first, and highly commended 659. This again points to the intricate work caused by mixing the special prize class animals with those of the Society. Three other rams were commended.

Class V.—*Shearling Ewes, pens of five:* 17 entries; 3 shown in this class alone, and 14 in the Society's Class III.—The first and second prizes were awarded to Messrs. J. and E. Crane. Mr. Mansell and Mr. Holland's sheep were commended.

Class VI.—*Cheviot Sheep, Shearling Rams:* 3 entries.—These were very useful animals, and must have shown the Welsh breeders that much improvement could be made in their native breed. Colonel Pennant received the first prize, and Mr. Sandbach, of Hafodunos, Denbigh, the second. Mr. Sandbach's other ram was commended.

Class VII.—*Aged Rams:* 5 entries.—The first prize was awarded to Colonel Pennant, and the second to Colonel Biddulph, Chirk Castle, Denbigh.

Class VIII.—*Shearling Ewes:* 3 entries.—Colonel Pennant was placed first, and Mr. Sandbach second.

Class IX.—*Pens of* 5 *Ewes:* 4 entries.—This was a bold-looking class, and the ewes were particularly large in frame. Colonel Pennant received the first prize, and Mr. Sandbach the second.

There is thus ample evidence that the Cheviot sheep will thrive in Wales. Colonel Pennant's agent, Mr. Doig, writes me:—

"The Cheviot sheep do remarkably well in Wales; they are very hardy, and also *invaluable* as a cross with the Welsh mountain sheep, a system Colonel Pennant has been adopting for the last five years on a 2000-acre mountain farm. We keep a few hundreds of pure Welsh sheep, and find they can be greatly improved by care."

Again, Mr. Sandbach, the other successful exhibitor of Cheviots, writes me:—

"I have had Cheviot sheep here (Denbighshire) since 1844, and they have gone on improving. I generally get a good ram from Scotland every year. Their weights are double that of the Welsh sheep, and they are quite as hardy. Most of my land is 1000 feet above the sea, but drained and sown down with good grasses. The Cheviots are not common in Wales. I sell my wethers at 22 months old, when they weigh from 17 to 25 lb. per quarter, and averaged

In 1855	.. ..	£2 3s. each.
1856	.. ..	2 13
1857	.. ..	3 1

Draft ewes 5½ years old sell for 35s."

Class X.—*Shropshire Down Ewes: pens of* 5 *each.*—This was a splendid class. The two prize pens were the property of Mr. W. O. Foster, of Kinver Hill. The pen of old ewes, No. 1013, was the admiration of the public. Mr. Kettle had also some splendid ewes in this class which were justly commended by the Judges. Mr. Watson, one of the judges for these special prizes, has so well expressed my own opinion of the Shrop-

shire Downs that I quote his words:—"Classes III., IV., V., Shropshire Downs.—This valuable breed of sheep, most creditable to the exhibitors, is destined at no distant period to take possession of a large portion of the middling pastures of this kingdom. With good shape, a fair quantity of wool, and sufficient size of carcase, much inclined to fatten, and lay it on the best points, they cannot fail to attract the notice of rent-paying farmers over the kingdom; and if not forced too far, so as to weaken the constitution, it is predicted that they may become a valuable substitute for the delicate Leicesters, which are fast degenerating from over-forcing and close-breeding."

Pigs.

Class I.—*Sows of a large breed with a litter of not less than six Pigs:* 18 entries; 7 shown in this class, and 11 in the Society's Class III.—The prize was awarded to a 2 years and 9 months-old blue and white sow, the property of Mr. Wright of Minshull, Cheshire.

Class II.—*Sows of a small breed with six Pigs:* 17 entries; 5 shown in this class, and 12 in the Society's Class IV.—The prize was awarded to Colonel Towneley's first prize sow, in Society's Class IV. Mr. Hindston's second prize sow was highly commended, and No. 1024 commended.

There is a remarkable fact apparent in the preceding notes upon our National Meeting, viz.:—

That the country is much indebted to the talent of our early breeders, who, in those days of slow enterprise and small encouragement, propagated from animals that appeared to possess peculiar qualities worthy of cultivation.

Thus, the short-horn tribes have come from the Messrs. Collings' herd; the best North Devons from the late Mr. Francis Quartly; the Leicesters from the late Mr. Bakewell's flock; the Southdowns from the late Mr. Ellman.

While it is interesting to notice these incidents, it is no less a matter of encouragement to reflect upon the continued success of the present breeders who possess the direct lines of blood from these early families; as an illustration, Mr. Booth's are the nearest representatives of the Collings tribe of short-horns; the Messrs. Quartly, of their uncle Mr. F. Quartly's stock; Mr. Sanday, of the Dishley flock; Mr. Webb, of the Glynde flock; and so on: all indicating the importance of the one grand desideratum, purity of blood.

By these continued national results it is clearly shown that

crossing even "in the line" is a speculative, if not a dangerous proceeding. Again, while the system of "in and in" breeding is condemned by the public, it would appear that it must have been of use to our *leading* breeders; for while other breeders are glad to resort to the parent stocks, *they* keep their high position unassisted.

In conclusion, I quote the words of Mr. Jonas as expressed in his Salisbury Report:—"I feel that I may congratulate the Society on the great improvement which has taken place in the exhibition of our domestic animals since the first show of this Society; and if it were not considered out of place, I would beg of those gentlemen who are unsuccessful exhibitors not to complain of the Judges' decision, but carefully to examine (and this, too, divested if possible of all prejudice) the prize animal in the different classes by which their own animals have been defeated, and by a careful comparison of each they will be able to discover the faults, imperfections, and malformation of their own, and will return home fully determined to rectify errors, and thus accomplish one of the great aims of the Society, viz. 'the improvement of the breeds of our domestic animals.'"

Emmett's Grange, Exmoor.

XVI.—*Report on the Exhibition of Cheese at Chester, in July,* 1858. By HENRY WHITE, Steward of Cheese at the Chester Meeting.

CHEESE being the principal agricultural produce of Cheshire, the members of the Local Committee at Chester decided, with much propriety, that liberal prizes should be offered for its exhibition out of the funds at their disposal. Their chief object was to stimulate improvement in the manufacture of an important article of food for which the county has long been famous: their desire in a subordinate degree was to increase the attractions of the Society's show.

The amount offered in prizes was, for cheese, 370*l.*, and for butter, 15*l.*—besides 49*l.* given as rewards to dairymaids—the makers of the prize cheese. The prizes were limited to the kind of cheese usually denominated *Cheshire*, and the competition was confined to persons residing in that and the adjoining counties, and North Wales. It was arranged in three classes, namely:—

1. *Coloured Cheeses made in* 1857;
2. *Uncoloured Cheeses made in* 1857; *and*
3. *Coloured or Uncoloured Cheeses made in* 1858.

From the first two classes the *Champion Cheese* was to be selected by the Judges, and for this the prize of 100*l.* was offered, in addition to 10*l.* to the dairymaid. Exhibitors were allowed to compete in all the classes, but they were not allowed to gain more than one prize in each class; and the winner of the champion prize was disqualified from obtaining any other.

The following tabular statement shows the prizes offered, the number of entries, awards, &c.:—

Class.	Description.	Number of lots Exhibited.	Amount of Prizes.	Prizes to Dairy-maids.	Names of Prize-men.	Number in Catalogue.	——
			£.	£.			
	Champion cheese, 4 not less than 60 lbs. weight each	..	100	10	Geo. Willis	36	Jos. Salmon and Thomas Dutton, *highly commended.* H. B. Briscoe, James Cookson, and N. Tomlinson, *commended.*
1	Best 4 cheeses, not less than 60 lbs. weight each ..	58	30	5	R. B. Ankers	4	
	Second best; ditto		20	3	John Byram	6	
	Best ditto, not less than 40 lbs. and under 60 lbs. ..	9	20	3	C. Beresford	65	
	Second best; ditto		15	2	E. H. Martin, jun.	66	
	Best ditto, under 40 lbs.	3	15	2	John Churton	71	
	Second best ditto		10	1	Jon. Gresty	73	
2	Best 4 cheeses, not less than 50 lbs. weight each ..	40	30	5	J. Hartshorn	101	J. Byram and Mary Wrench, *highly commended.* John Churton, Wm. Palin, and Thos. Lowe, *commended.*
	Second best; ditto		20	3	R. B. Ankers	79	
	Best ditto, under 50 lbs.	8	20	3	P. A. Wood	122	
	Second best; ditto		15	2	Jon. Gresty	119	
3	Best 4 cheeses, not less than 60 lbs. weight each ..	52	20	3	Geo. Jackson	138	Joseph Whitlow, (Huxley Hall), John Lowe, T. Taylor, and Mary Wrench, *commended.*
	Second best; ditto		15	2	J. Cookson ..	177	
	Best ditto, not less than 40 lbs. and under 60 lbs. ..	7	15	2	P. A. Wood	190	
	Second best, ditto		10	1	J. Churton ..	189	
	Best ditto, under 40 lbs. each	4	10	1	Jon. Gresty	192	
	Second best; ditto		5	1	Wm. Acton	191	
		181*	370	49			

* Many of the competitors made entries in two, and others in all the three classes; so that the actual number of persons who made entries was only 119. 194 entries were made, but 13 of them failed to appear at the show.

Of the 194 entries, 178 were made by persons resident in Cheshire, 7 came from Denbighshire, 5 from Staffordshire, 3 from Shropshire, and 1 from Derbyshire. With one exception (the prize obtained by Mr. E. H. Martin, junior, whose farm is in Staffordshire), the whole of the prizes have been awarded to Cheshire farmers; and the exception I have named is that of a farm bordering on Cheshire, which is occupied by the son of a Cheshire land-agent, and the cheese was made by a Cheshire dairymaid.

The cheeses were arranged in a double row along the centre of a shed 487 feet long and 20 feet wide, and having a ceiling of canvas. This assisted very much in moderating the temperature, which, as might be expected in July, was somewhat too warm for the exhibition of cheese.*

The *weight of all the cheese exhibited* was about 20 tons. The average weight of the four champion cheeses was 107 lbs. each—my estimate of the largest of the four from measurement being 111 lbs. It is now the practice to make Cheshire cheeses much *thicker* than formerly in proportion to their diameters. Their appearance is thus considered to be improved; and although in cheese, as in other things, that which is best looking is not always really the best, it did so happen at Chester that the champion cheeses were not only the best in quality, but, according to our present notions of symmetry, among the handsomest in shape.

In the rules for the exhibition, the privilege was reserved to the Local Committee of purchasing any of the prize cheeses for the Society or for presentation, at a price to be fixed by the Judges. The Committee, therefore, determined on buying the four champion cheeses to which the prize of 100*l.* had been awarded, and presented one to the Queen, one to the Emperor of the French—through his ambassador, the Duc de Malakoff, who was present at the show and dinner,—one to the Earl of Derby as Prime Minister, and one to the then President of the Society, Lord Berners. A prize cheese of Mr. Ankers, in Class 1, was also bought and presented to the Society for the public dinner.

It will perhaps not be uninteresting to readers of this article if I here record the *dimensions* and *estimated weight* of one of each of the prize cheeses:—

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* The heat of the other sheds in the show-yard where thermometers were kept was about 70° in the middle of the day, and that, I presume, would be about the heat of the cheese-shed.

—	Number in Catalogue.	Mean Diameter in Inches.	Depth in Inches.	Contents in Cubic Inches.	Estimated Weight in lbs.
Champion	36	17	$13\frac{1}{2}$	3064	111
Class 1	4	$15\frac{3}{4}$	$11\frac{1}{4}$	2191	79
	6	$17\frac{1}{4}$	11	2570	93
	65	$15\frac{1}{8}$	8	1437	52
	66	$13\frac{1}{4}$	$8\frac{1}{2}$	1172	43
	71	$13\frac{1}{2}$	$7\frac{1}{4}$	1037	38
	73	$11\frac{1}{2}$	$6\frac{3}{4}$	701	26
Class 2	101	$16\frac{1}{4}$	$10\frac{1}{2}$	2177	79
	79	$15\frac{3}{8}$	$11\frac{1}{4}$	2088	76
	122	$12\frac{5}{8}$	$8\frac{1}{2}$	1064	38
	119	$12\frac{3}{4}$	$7\frac{1}{2}$	957	35
Class 3	138	$18\frac{5}{8}$	$9\frac{1}{2}$	2598	94
	177	$20\frac{7}{8}$	$10\frac{1}{2}$	3593	130
	190	$13\frac{7}{8}$	$8\frac{3}{4}$	1323	48
	189	14	$10\frac{1}{2}$	1615	59
	192	$12\frac{1}{2}$	$6\frac{3}{4}$	828	30
	191	13	$7\frac{1}{4}$	962	34

Note.—In estimating the weight from the contents in cubic inches, I have adopted a common divisor of $27\frac{1}{2}$, there being usually that number of cubic inches in a pound of sound cheese. This datum is the result of several investigations, and is sufficiently correct for ordinary purposes; but it must not be concluded from it that all Cheshire cheese is of the same specific gravity.

Amongst the new cheese (Class 3) the four exhibited by the Misses Wrench of Huntington, near Chester (No. 183 in Catalogue), were "commended" by the Judges, not so much for their superior quality—on which the Judges gave no opinion, for the cheeses were too young—as for their extraordinary size, and for the skill and labour which must have been exercised in the compacting of the enormous bulk of curd from which they were made. The diameter of the two largest was $24\frac{3}{8}$ inches, and the thickness 18 inches. The weight would, therefore, be at least 300 lbs. each, and the weight of the other two similarly calculated would be about 150 lbs. each. One of the Judges, referring to these large-sized cheeses, says, that, "while they will be admired as curiosities, they should not stimulate imitation."

Exhibitions of cheese have for many years formed part of the attraction at the Cheshire Agricultural Society's show, and occasionally at other local societies' shows in Cheshire and Lancashire; but the exhibition at Chester far surpassed anything ever seen before in these counties or in England. It excited the admiration, not only of strangers, but of the farmers of Cheshire themselves, and particularly of their wives and daughters.

At the local shows referred to, which are usually held in September or October, *new cheese only*—say four or five months old—is exhibited; but at the Royal Society's Show at Chester

there were 118 exhibitors of *old cheese* (from 9 to 12 months old), besides 59 of *new*. There was, however, one disadvantage at Chester which does not attach to the local shows—the new cheese (Class 3) had most of it necessarily been made only about two months previously, and some of it was, therefore, too young for use, and consequently too young to be judged. It is, however, right to state, that "early maturity" even in cheese-making is often aimed at, and that cheese is not unfrequently ready for the Manchester market, when not more than two months old.

There is an impression, I believe, existing in the minds of some of the exhibitors which I wish to remove—that, in awarding the prizes, a degree of favouritism was shown by the judges towards the coloured cheeses, which are principally made for the London market; and also that there were too many judges from London, or judges representing the *London taste*, which is still unfortunately in favour of coloured cheese.* It will not be difficult, I trust, to show that such surmises are not in any way grounded upon fact. In doing this I will state first the course adopted in the appointment of the judges. Twelve were nominated by the local committee at Chester, and from these six were selected by the Council in London, two being resident in that city, one at Birmingham, one at Manchester, one at Liverpool, and one at Tarporley. It so happened, however, that, in consequence of the illness of one of the London judges, the cheeses in Classes 1 and 2 were adjudged before his substitute (also from London) arrived; so that for these classes there was only one London judge present, whose influence, even had it been unduly exercised—which I am sure it was not—would hardly have had the effect of biassing his colleagues. In Class 3, where both the London judges *were* present, and where both coloured and uncoloured cheeses competed, it will be seen that the prize was given to the latter kind.

Much speculation was rife before the show as to the *modus operandi* which would be adopted by the judges in the discharge of their onerous duties, and in arriving at their decisions; and it was, I believe, supposed by some that they would have to *taste*, if not to *eat*, at least a small portion of each of the 724 cheeses exhibited. Fortunately for the judges, this was not necessary. It will not perhaps be out of place if I describe the process adopted. In the first place, the cheese of each exhibitor was bored with the iron augur or scoop used by cheese-factors, and the specimen thus obtained was examined as to colour, composition, and odour. Occasionally the consistence, and, still more

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* One of the country judges says he has heard Londoners say *they could not bear white cheese, they liked the cheese to be of the natural colour.*

rarely, the flavour were ascertained, but, as a rule, the opinion of the judges was determined by the first-mentioned qualities. And here I may note by the way that exhibitors were not allowed to bore, or in any way try the cheeses before bringing them to the show; *if they had been so allowed*, their selection would no doubt have been better than in many instances it proved to be; but it is probable that the samples would not have been so fair a representation of the bulk.

In estimating the different degrees of excellency it is usual for each of the judges to note for his own guidance what he considers the market value per cwt. of each lot. This was done by some, if not by all, of the judges at Chester; and after boring the whole of the cheese which competed for any particular prize, the notes were compared, and certain numbers agreed upon as the best. A second inspection of these then took place before the borings were redeposited in the cheese, and before awarding the prizes, which were in every case assigned by *unanimous decisions.* In the 3rd Class there was, if I remember rightly, a doubt in the mind of one of the judges to which lot of cheese the first prize should be awarded; but ultimately he was satisfied with the decision of the other five, and the award was made without a division, and in favour, as I have before stated, of *uncoloured* cheese, the second prize being given to a *coloured* one.

As one proof, amongst others which I am about to adduce, of the correctness of the decisions of the judges, I may mention a circumstance with reference to the champion cheese. The judges, who were of course in entire ignorance of the names of exhibitors, decided that No. 36 was the best in the first class (*coloured* cheese of 1857), and No. 104 the best in the second class (*uncoloured* cheese of 1857), both these lots being made in the same dairy! The judges had now to determine to which of these two the champion prize should be awarded. After a rigid scrutiny, they ultimately decided in favour of No. 36 (the coloured cheese); for, on re-examination of both lots, they found that one of the four uncoloured cheeses (No. 104) was "a little bitter," and another "a little too salt." I afterwards ascertained from Mr. Willis, the owner of these cheeses, that the champion cheeses (No. 36) were made in September, when the cows were fed on *grass only*, and the others (No. 104) when the cows had commenced eating *a few turnips with the grass*, which would more or less deteriorate the flavour.

But to proceed. Mr. Willis, the winner of the champion prize, being disqualified from obtaining any other, the first prize in the first class was awarded to No. 4 (Mr. Ankers), to whom was awarded the second prize in the second class—being another proof that, where the cheese was from a good dairy, the judges

found it out, although presented to them in one case as coloured, and in another as uncoloured. As a further proof of the discrimination of the judges, I may mention that Mr. Churton, who, it was decided, had the best cheese in Class 1 under 40 lbs. weight, and who was commended for his cheese under 50 lbs. weight in Class 2, had also awarded to him the prize in Class 3 for cheese not less than 40 lbs. weight, nor more than 60 lbs. Mr. Jonathan Gresty was also awarded prizes for small cheese in all the three classes.

Mr. George Jackson, who obtained the first prize for new cheese of not less than 60 lbs. weight in Class 3, obtained also the first prize for similar cheese, under 50 lbs. weight, at the Manchester and Liverpool Agricultural Society's Show at Manchester in September, and at the Cheshire Society's Show at Over in the same month, competing in both instances with several of the same persons whom he competed with at Chester, some of them being famed makers of the best cheese sold in the Manchester market, and known as "honeycomb." Mr. Palin's and Mr. Briscoe's cheeses, which were commended at Chester, obtained respectively second and third prizes at Manchester. Mr. P. A. Wood, who obtained two prizes at Chester, one by coloured and another by uncoloured cheese under 60 lbs. and 50 lbs. weight respectively, obtained the first prize at Manchester for cheese not less than 25 lbs. weight, and the first at the Cheshire Society's Show for the best, not less than 20 lbs. nor more than 50 lbs. weight. Mr. William Acton, who obtained a second prize for cheese under 40 lbs. weight at Chester, obtained a third prize at Manchester for cheese not less than 25 lbs. I think the concurrence of these decisions goes far to prove that the judges acted with great discrimination, and with unbiassed judgment.

It will be seen by reference to the table given above, that the competition amongst the *exhibitors of cheese of the large size* was exceedingly good, and it was a subject of regret to the judges that there were not a greater number of prizes at their disposal. The competition amongst the *smaller-sized cheese*, and particularly of the *smallest*, was not good. This might arise from the unwillingness amongst small farmers to subscribe twenty shillings each, as required by the regulations of the local committee, to entitle them to compete.

One of the London judges assured me that cheeses under 40 lbs. weight, though only of middling quality, "are in very general request, and readily sold, while larger-sized ones not fine in quality are not so much wanted;" and, he adds, "it is to be regretted that cheeses of this size are not more generally produced."

I should not have considered it necessary to have written so

fully in explanation of the course pursued by the judges, and in justification of their award, if the public had had the same means of testing the correctness of the decisions as is afforded in other departments of the show. Mere external examination of a cheese is not sufficient to determine its quality; and more than this could not be allowed to the public; for if it were, the damage might be serious. The very natural desire of the spectators to *taste* some of the cheeses is so great that it requires the strictest surveillance to prevent their doing so. It would be well if by sale of small portions, or by some other arrangement, they could at any future show be allowed to gratify their curiosity, at least so far as the prize cheese is concerned.

Since the show I have been favoured with some opinions and observations from the judges, chiefly in answer to inquiries which I have made from them; and although they are not so favourable as I could have wished, I feel nevertheless bound to communicate them.

And first, as to the colouring matter "Annatto;" its effect on the appearance and flavour of Cheese, and on its sale in particular districts.

Of the 58 samples of large cheese shown in Class 1, Mr. Hewitt, one of the London judges, says:—

"Above half of them were defective in colour, and flavour. . . . I mean as respects those which were not true in colour,* that there were in some light spots or specks, and in others a dark or shady colour. A perfect colour may be either deeper or lighter; but it must be true, clear, and all alike. I do not think there were above one or two samples that had too much colour, so as to be a deep or *foxy* red. . . . . I cannot say much about 'annatto.' Sometimes it is inferior; but good colouring matter, if not properly used, will cause a cheese to be bad in colour. I have heard of vitriol being used, and in such cases, when the cheese is cut, the colour will appear true and perfect, but on being exposed to the air, it goes bad."

Mr. Edward Corderoy, the other London judge, says:—

"The colour, where it is genuine, makes not the slightest difference in the quality or the keeping character of the cheese. Coloured cheese is preferred here from habit. Where 'annatto' is bad, it affects the flavour and quality injuriously."

Mr. John Moss, the Manchester judge, says:—

"About twenty years ago this neighbourhood took largely of coloured cheese, and Yorkshire none else; now, nine-tenths of the cheeses sold here for consumption in this locality are *white*, and several of the large towns in Yorkshire are now using that kind. . . . . As to which is best, the red or white, entirely depends upon fancy; I would take white. I think I can safely say that this town takes the white cheese at a higher price than any other town gives for coloured. London factors for a fancy lot sometimes give a long price,

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* The term *true coloured* amongst cheesefactors means of *uniform colour*. When cheeses have not this appearance they are rarely of good quality.

and so do we. . . . Jackson's cheese was white, and it was the best at the show *for its year*. Ankers's was all but white for Class 1: it was so pale that we were nearly disqualifying it."

Mr. James Watson, the Birmingham judge, says:—

"The greatest part of the consumption in this neighbourhood is of pale or uncoloured cheese, the produce of the counties of Derby, Stafford, Warwick, and Leicester. These are made thin and flat, varying in weight from 10 to 40 lbs. In this and the adjacent mining districts of South Staffordshire and Worcestershire, the heavy consumption is of cheese weighing from 20 to 30 lbs. each. *Cheshire* is only in limited demand: we require fine qualities of it coloured, the bright straw colour being preferred."

Secondly, as to the quality of the Cheese exhibited, and some remarks on the different varieties.

I have already quoted Mr. Hewitt's remarks on the large-sized cheeses in Class 1. Of the others in that class he says, "they were chiefly of middling quality." Referring to Class 2, he says:—

"There were about forty samples of uncoloured cheeses, not less than 50 lbs. weight. Many were very indifferent, and some in rough condition, known technically as *honeycomb* cheese. These we do not approve, and would not by any means recommend as worthy of imitation. . . . The new cheeses made in 1858 were exhibited under unfavourable circumstances. The period was too early (July 19) to show any new cheese to advantage, and the weather being warm prevented the cheese being settled and cool enough for examination; but there were about fifty samples of new cheeses not less than 60 lbs. weight of very good fair character and condition."

Of the smaller-sized cheese shown in this class, Mr. Hewitt says:—

"There might have been better specimens exhibited and more encouragement given to this very useful size in cheese."

Mr. Watson (Birmingham) says:—

"The *honeycomb* description (some of which was shown at Chester, and is, I understand, in high repute in some of the Yorkshire towns) is never seen or inquired for here. To obtain this cheese in its *mity* and decomposed state, a great sacrifice of weight is entailed. As a rule, I should say the coloured cheese brings the highest price of Cheshire make. I am, however, told that the *honeycomb* description will in some towns bring a fancy price; but, as it entails a considerable sacrifice in weight to prepare it, I conclude it is not desirable to stimulate its production. I adhere to the principle, and lay it down as a rule, that it is desirable to produce a marketable article in the shortest time—regard, of course, being had to expense in so doing. The old cheese shown at Chester, being kept beyond the usual time, was fairly tested as to its keeping qualities. For the new cheese, made in 1858, I consider the show was too early, especially for the large thick kind; neither our dairymen nor science having yet discovered a process by means of which ripeness at that early period can be effected. Thinner and smaller cheese would have a better chance; but even for this class a month or two later would be more desirable."

Mr. Bate, of Tarporley, Cheshire, says:—

"Cheshire cheeses, as a whole, are more perishable now than they were twenty years ago. They are made *cooler* * to leave them open grained, and so that they may get ready earlier. This may be more lucrative than the old plan of keeping cheese a year; but we have still many fine dairies of cheese made on the old plan, and which, when sold, fetch the highest price in the London market. I am not disposed to say that cheese is worse than it was twenty years ago, although the increase of quantity through bone-manuring is very great. The richest cheese is made in September or October: the milk is then smaller in quantity, and is so rich that some cream is generally skimmed from it before making it into cheese. By so doing there is less difficulty in getting the cheese to stand; as the weather is then getting too cool for clearing well the curd of its whey. The fine large open-coated *mity* cheeses you call *honeycomb* are only of great value when they go *blue mould* all through; then they are equal to Stilton. It would not do for this style to prevail; they have to be kept so long and they lose so much weight, that they must sell high. The best cheese made is firm and imperishable, keeping in the farmer's room until the year after it is made, or longer if required. The texture will be *solid* but not *tough*, and the flavour *fine*. It may be brought to the table for weeks and perhaps months after being cut, without getting dry or becoming worse from exposure to the air. To obtain this character of cheese by a three or four months' process is what we want."

Thirdly, Remarks and Suggestions for the future exhibitions of Cheese, and for promoting improvements in its manufacture.

Mr. Corderoy says:—

"That the exhibition of *new* cheese so early as July offers very little opportunity for the exercise of a sound judgment, because it encourages farmers to force cheese to an appearance of ripeness by artificial means, and also encourages an unfair estimate of value by the judges. The prizes at Chester were awarded on the avowed principle of giving them for the *best* and *ripest* cheese at the time, though it was openly acknowledged that these would deteriorate, while others, put as second best or passed over, would improve. The remedy I beg to suggest is—(1.) To defer the exhibition of new cheese till the end of September or October, by which time it would have a fair degree of ripeness by natural means. (2.) To agree upon a standard of quality, colour, and flavour. If this cannot from any circumstances be procured in Cheshire, then a really fine Cheddar cheese should be selected, which the judges should agree has all the characteristics of fine cheese. (3.) Ten or twenty cheeses should be exhibited instead of four. (4.) It should be an instruction to the judges to have regard to the condition of the cheese, and to the probability of its keeping sound in the coat and at the edges with fair treatment.

"These form the principal suggestions I have to make. I may add, that I have a strong opinion that the large application of artificial manures during the past twenty years to the dairy districts of Cheshire, has necessitated a change in the methods of making cheese—the character of the land being quite changed. What the change should be I am not prepared to suggest, not being so much acquainted with the process of manufacture as with the qualities of cheese when made. But, before the application of these manures, perhaps only one dairy in fifty became seriously deteriorated in condition without external damage; *now*, probably, only one dairy in fifty will remain fine and

* This term is well understood amongst the dairymaids and others in Cheshire: it refers to the heat of the milk at the time of the coagulation.

sound in the coat and edges through the season, and numbers of them grow rotten and fall to pieces, notwithstanding every attention."

In reply to my inquiry respecting uncoloured cheese, Mr. Corderoy says:—

"We do not sell *white* cheese; but we believe these are made more loosely —to cut more open—for the Manchester market, than the coloured cheese made for London."

He adds—

"We want cheese rich, solid, fine-flavoured, true-coloured, firm, sound, handsome, and that will go on to improve for twelve months. How to get it is the problem for the Royal Agricultural Society."

Mr. Watson says:—

"I attribute the cause of so many secondary and middling dairies to want of skill in manufacture, unsuitable utensils for the milk, and insufficient buildings for the making; also to the want of properly-ventilated rooms whilst drying, and especially to the not keeping up a proper temperature (by artificial means) during that process. . . . . The attention of practical men should be directed to the supply of a want which is much felt in Cheshire—that of *skilled dairymaids*. Many farmers would, I know, fairly remunerate such persons if they could be got. Domestic servants too often change, and some are inexperienced. It is worthy of consideration whether women, or even men, of more mature age, should not be employed where the mistress herself does not make the cheese."

Mr. W. Tilston, of Liverpool, and of Upton, near Chester, says:—

"Cheese of late has become very much out of fine sound condition. A complete change seems to have come over the quality and description of cheese the last few years, as it cannot now be kept until a second summer in sound condition. This I cannot account for in any other way than by the very prevalent practice of dairymaids now omitting to apply salt externally. This has the effect of hardening the rind, which resists the flies and renders the cheese firm, so that they can be handled and moved about when new without damaging them; whereas, without this application of salt, the cheeses are so exceedingly tender that the most careful and experienced hand can scarcely remove them without a blemish. The fly soon finds out the blemishes, and assists the decomposition which usually takes place.* In Lancashire the cheesemakers frequently trust to external salting only for the care of their cheese."

With many of the remarks of the judges I quite coincide; but from the suggestion that 20 cheeses, instead of 4, should be brought to the show, I must differ. I admit that 4 cheeses are scarcely sufficient to represent the quality of a dairy, in which there may be from 200 to 300 made in a year; but I think it very probable that the cheesemakers would decline exhibiting at all if so many

* A full description of the *cheese fly* and *cheese maggot* is given in Stephens' 'Book of the Farm,' and in the 'Rural Cyclopædia,' by Wilson. An account of the *cheese mite* may also be found in these publications.

as 20 were required to be sent to the show. Besides, the additional shed-room thus rendered necessary would be so large as to make the carrying out of the suggestion very difficult, to say nothing of the great additional labour which would be imposed on the judges.

It has been proposed that any future exhibitions of cheese, in connexion with the Society, should be in September or October; but it is not likely that the Society will have an exhibition of this article distinct from their show of cattle, which is always in July.

I have already suggested to the Council, through the Secretary of the Society, the desirability of prizes being given next year for cheeses of different kinds—say for Cheshire, Gloucester, Cheddar, and Stilton. If July is considered too early for showing *new* cheese, let the prizes be confined to *old*—that is, to cheese made in the year previous to the show.

As to whether Cheshire cheese is better or worse now than it was 20 years ago, I feel incompetent to decide; but I am persuaded that, *on the whole*, it is not so good as it ought to be, and that thousands of pounds are lost annually by farmers in Cheshire and the adjoining counties, in consequence of their making it of an inferior quality, which compels them to submit to an inferior price. Should any doubt this assertion, let me tell them that there are at this time (Oct. 1858) large quantities of inferior cheese selling by the farmers for less than 50*s.* per 120 lbs. (the lowest being about 45*s.*), whilst the best is disposed of at 70*s.* and even 73*s.*, and the average quality at 55*s.* to 60*s.*

But, whilst admitting that much inferior cheese is made, I wish also to bear testimony to the excellence of the produce of many of the Cheshire dairies. It is well known that several of the best makers of cheese declined to exhibit at Chester. Having already, and deservedly, obtained a good name, and knowing that, where the competition was likely to be so great, many really good dairies would necessarily be excluded from prizes, they considered it prudent not to risk, by contest, the loss of any portion of the fame they already possessed.

There is an impression on the minds of many cheesefactors and others that Cheshire cheese has deteriorated in quality ever since, if not in consequence of, the very general application of bone-manure to the grass lands; and there is, I believe, no doubt that the superior herbage which this application induces does render more care necessary in the management of the produce of the cows, when converted into cheese. But if any proof be wanted that good cheese of the first quality can be made on farms on which bone-manure has been freely applied, we have it in the fact that Ridley Hall Farm, where the champion cheese was made, and most, if not all the farms on which the other prize-

cheeses were made, are bone-manured.* All, therefore, that is required is, that more care, skill, and intelligence should be exercised in the manufacture: with these, and proper utensils and offices, good cheese may be made on any Cheshire farm. At the same time I think that the importance of cheesemaking is such as to demand much more scientific investigation than has hitherto been bestowed upon it; and I hope ere long that either the Royal Agricultural Society, or some other, will cause that investigation to be made.

Thousands, I doubt not, are ignorant of the fact that the cheese they eat (and much of the butter also, especially in winter) is artificially coloured; others probably know that colouring is employed, but fancy that it is necessary, or that it improves the flavour. Now, I wish to inform the former of these parties that all cheese that has not the appearance in colour of milk or cream is coloured, and *both* that the colouring matter is not only useless, but very objectionable.

This ingredient is, or should be, annatto (or annotto), the produce of the bixa orellana of Linnæus. It is, I believe, chiefly imported from the West India Islands, and used for dyeing. The colouring commonly used in cheese-making is prepared by manufacturers in this country for the purpose. It gives the cheese that amber appearance which is unfortunately required in order to please or deceive the eye of the London consumer. For the Manchester and Liverpool markets and for home consumption the Cheshire farmer rarely uses it in his cheesemaking, as it is well known it does no good; but if an inferior article is bought, and especially if much be used, it may deteriorate the flavour very much. Those who wish to be enlightened on this subject would do well to read the 'Essay on Cheese-colouring,' written by Mr. Whitley, of Stretton, published by Mr. Ridgway, in which it is clearly proved that the greatest bulk of the cheese-colouring used in this country is only an imitation of annatto, but sold by that name, and consisting of such ingredients as turmeric powder, potash, and soft soap or train-oil, well mixed with a little real Spanish annatto.

Now, in the first place, I would ask, are our London friends or any others willing to have such compounds as these administered to them, although only in homœopathic doses?—for I can assure them it is entirely their own fault that they are so administered. The dairymaids will gladly give up infusing this nauseous compound into their cheeses whenever the London cheesefactors ask

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* The farm at Ridley Hall is 445 statute acres, of which about 300 are in pasture and meadow; 151 acres of the pasture land were *boned* by the tenant in the years 1854, 1855, and 1857. The champion cheese was made in September, 1857.

them to do so; and I doubt not the factors will as willingly give up buying coloured cheeses whenever their customers (the consumers) are content to give up eating them.

Even admitting that the colouring matter used is a genuine preparation from annatto, it is a most disagreeable, not to say disgusting, thing both to the smell and taste, and has the further objection of being an expensive article, the retail price being now 7*s.* 6*d.* per lb. It is estimated that 1 lb. is sufficient for colouring a ton of cheese; but I have no doubt in many dairies much more than this proportion is used. In Gloucestershire the estimate formerly was 1 lb. for half a ton of cheese. As it is not improbable but that more than 6000 tons of coloured cheese are made in Cheshire, at least 6000 lbs. of colouring matter are required, and will cost 2250*l.* This amount is, no doubt, trifling when compared with the value of the cheese; but the absurdity of the thing is, that it is so much money indirectly paid by the consumers in London and elsewhere, and imposed upon themselves, in order that they may have the gratification of eating an adulterated article.

The remaining portion of this Report has reference to the *manufacture of cheese;* but it has a direct bearing on the exhibition, as will be seen by what follows.

When the Committee at Chester determined upon giving prizes for cheese, it occurred to myself and others that the opportunity should not be lost of obtaining, if possible, some information on the subject of cheesemaking. With this in view, a number of queries were drawn up by a Sub-Committee, which were to be answered, at their option, by parties competing for prizes; it being understood that their refusal was in no way to interfere with their privileges as competitors.

In a Report of the 16th February, 1858, the result of the Local Committee's deliberations on this subject is given as follows:—

> "Your Committee, being anxious to seize every opportunity arising out of this great exhibition to improve the agriculture of this locality, resolved on submitting a series of questions, to be answered by the competitors for prizes offered for cheese, with the view of ascertaining, as nearly as possible, the system practised with the greatest success; and your Committee, with the assistance of Messrs. H. White, J. Palin, W. Palin, G. Jackson, Tilston, and H. B. Briscoe, have decided on the following form, which they recommend should accompany each certificate for cheese, with the request that it may be carefully filled up, and returned under seal to the Secretary, and to remain in his hands unopened until after the prizes shall have been decided. By this means materials would be secured for the purpose of an important publication, should such be the decision of the Committee."

It is unnecessary to give here a complete copy of the form referred to in this Report: the questions asked are, however, indicated in the following Table, in which I have given the

answers of three of the prize cheese-makers. The first was the maker of the champion cheese, the second the winner of the highest prize in Class 1 (coloured cheese of 1857), and the third the winner of the highest prize in Class 3 (coloured or uncoloured cheese of 1858). The person obtaining the highest prize in Class 2 made no return.

FORM OF QUESTIONS AND ANSWERS.

QUERIES.	Answers of Mr. Willis. (Champion Cheese, 1857.)	Answers of Mr. Ankers. (Cheese not less than 60 lbs. weight, 1857.)	Answers of Mr. George Jackson. (Cheese not less than 60 lbs. weight, 1858.)
1. Number of cows?	96 cows.*	36 cows.	28 cows.
2. Month when the cheeses were made?	Latter end of September, 1857.	Last week in September, 1857.	The last week in May, 1858.
3. Treatment of the cows?	Turned out to grass.	Turned out to grass regularly.	Out at grass.
4. Nature of the land and kind of pasture grazed at the time of making the cheese?	Strong and light soil, part drained. Part old turf, part clover and ryegrass.	Strong soil, drained. Old turf. Natural grass of many years' standing.	Light soil, drained where required. A part old pasture, the rest rye-grass and clover.
5. Hours of milking?	From 5 to 6 o'clock, night and morning.	5 o'clock A.M., and 5 P.M.	6 o'clock.
6. Has any part of the dairy pasture-land been manured with bones?	80 acres boned in 1854, 26 in 1855, and 45 in 1857. Boiled bones.	All the pastures have been boned twice, and some thrice. The last time partly in 1853, 1854, 1855, and 1856.	With raw bones. The greater part three times over.
7. Is the ranunculus (buttercup) or carex (carnation grass) prevalent in your dairy pastures?	Yes. Harmless.	In some pastures the ranunculus is prevalent. I consider them rather injurious to the dairy.	
8. Kind of vessels in which the milk is kept before using?	Tin.	Tin.	Tin pans and mugs.
9. How many meals' milk were used in the cheeses made for competition?	Two meals.	Two.	Two.

* 96 cows were, I presume, the number actually giving milk at the time the cheeses were made in September, 1857. The number that I found on the farm, on going to see it in August, 1858, was 118.

FORM OF QUESTIONS AND ANSWERS—*continued.*

QUERIES.	Answers of Mr. Willis. (Champion Cheese, 1857.)	Answers of Mr. Ankers. (Cheese not less than 60 lbs. weight, 1857.)	Answers of Mr. George Jackson. (Cheese not less than 60 lbs. weight, 1858.)
10. Temperature at which the milk receives the rennet?	75 degrees.	We use the thermometer. 78 to 80 degrees.	
11. Means used in the after process to keep up the heat in the tub?	None.	Heated water in pans, or pans of milk floated in boiling water.	None.
12. Mixture of the milk in the cheesetub?	The old put in after the new.	The old after the new.	New to the old.
13. Curd-breaking?	Usual wire breaker.	A sharp cutting tin, to cut clean through, and afterwards break with the hands.	The usual wire breaker.
14. After-treatment of the curd?	Allowed to settle, then turned to one side by hand; whey got off; curd removed to baskets.	Various, according to the season and temperature.	
15. The addition of salt?	Salt added in a damp state: a little on each layer; cut up three times and turned over; ground by curd-mill and put into vats.	It is measured in a dry state; and according to flavour, applied in the second and third breaking.	By guess.
16. How is the dry curd broken?	Cornes' curd-mill.	By hand.	Curd-mill.
17. Pressure?	Nothing first day. About 2 cwt. second day.	None the first day. On the second day six or eight pounds *with* the lever. [Qy. *on* the lever?]	Screw the first day and lever afterwards.
18. Time taken to complete the cheese-making?	Five hours.	Six hours.	Six hours.
19. Use of skewers during the process? [See below.]	Used during the first three days.	Used the second day, up to the time of taking the cheese from the press.	Not used.

FORM OF QUESTIONS AND ANSWERS—*continued.*

QUERIES.	Answers of Mr. Willis. (Champion Cheese, 1857.)	Answers of Mr. Ankers. (Cheese not less than 60 lbs. weight, 1857.)	Answers of Mr. George Jackson. (Cheese not less than 60 lbs. weight, 1858.)
20. Removal of the cheeses from the dairy to the cheese-room?	In six days after making.	From the fourth to the sixth day, according to their dryness.	Fourth day.
21. Heat of cheese-room?	Unknown.	45° to 55° or more, according to outdoor temperature.	Over the kitchen, where there is a fire.
22. Artificial means of heating the cheese-room?	None.	A fire under the cheese-room.	None.
23. When ready for the market?	From three to four months.	In six months or more.	Two months.
24. The use of colouring?	Fulwood and Bland's imperial annatto: 1 lb. to 1 ton 3 cwt. of cheese.	The cake: half an ounce to 1 cwt. of cheese.	[Uncoloured cheese].

The number of answers received to these queries was thirty-six. Of these thirteen were from competitors who received either prizes or commendations, and whose cheeses, it may reasonably be supposed, were made at least upon a good, if not upon the best system. I propose therefore now to give as correctly as I can the *substance* of these thirteen replies. The marginal numbers, it must be understood, refer to those of the preceding queries, and the answers I am about to condense include the three I have already given.

(1 and 2.) The number of cows kept on the farms varied from ninety-six (Mr. Willis's) to fifteen (Mr. Gresty's). Assuming the estimate of the weight of the prize cheeses to be correct, the quantity of cheese made per cow in September and October (Classes 1 and 2) was $2\frac{1}{8}$ lbs. per day—weighed at nine or ten months old—and upwards of 3 lbs. per cow per day at the end of May (Class 3), weighed when about six or eight weeks old.

(3.) Cows all turned out to grass.

(4.) The soils were both strong and light. The grass was most of it old, but some of it new, and some was ryegrass and clover.

(5.) Milking hours 5 to 6 or $5\frac{1}{2}$ to $6\frac{1}{2}$, night and morning.

(6.) Bone manure applied to the grass lands of all the farms except one, boiled bones being the kind most used.

(7.) The ranunculus and carex are considered harmless by

some, injurious by others, and are said not to be present on four of the farms. [The answers on this point are, with one exception, very unsatisfactory, and clearly show that little or nothing is known as to the effect of this herbage on cheese-making. My own opinion is that both ought if possible to be extirpated.]

(8.) The milk is kept by eleven of the thirteen in tin; by one in tin and brass, and by one in earthenware.

(9.) Two meals' milk used in making each cheese.

(10.) The heat at which the milk is coagulated is stated by No. 36 to be 75°; by No. 4, 78° to 80°; by No. 6, 78° to 80°; by No. 116, 75°, and a little warmer in cold weather; and by No. 98, 80° in summer, and as high as 86° in spring and autumn, and 90° in cold weather.

(11.) Means are rarely used to keep up the heat of the milk or curd in the cheese tub.

(12.) In eight instances the old (or night's) milk was put to the new, and in five the new to the old.

(13.) Eleven used the wire-breaker, two the hands.

(14.) The description of the process of cheese-making is imperfectly given by all except one, and as his account is long, and varies but little from that given by myself in the Essay previously referred to, I do not consider it necessary to repeat it here.

(15.) The salt is chiefly applied to the curd by *taste* or *guess*; even where quantities are given, they cannot, I think, be relied on, except in the case of Mr. Briscoe, who states that he uses 2 lbs. to an 80-lb. cheese. One party says that 4 lbs. are used to a 60-lb. cheese,* and another that ten single handsful [about $1\frac{3}{4}$ lbs.] are used for a cheese of that weight. The salt is applied when most of the whey has been extracted, and when the curd is being broken by hand or by the curd-mill.

(16.) Curd-mills for breaking the curd are used by seven; six break by hand.

(17.) Eight use lever presses; five do not. Some apply no weight the first day, others very little, and the rest from 10 lbs. to 30 lbs. The weight is increased the second day. On the fourth day Mr. Palin applies 10 cwt., and afterwards a ton. Mr. Willis does not state his weights, but his three heaviest cheese presses are not more than $\frac{1}{2}$ a ton each, if so much.

(18.) The process of cheese-making is stated to occupy from five to six hours.

(19.) Eight used skewers [to create drains for the discharge of the whey], five dispensed with them.

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* This must have been stated from guess, and must be erroneous. The flavour of the three lots of cheese shown by the lady who gives this answer indicates a much smaller quantity.

(20.) The cheeses are removed from the dairy or (so-called) salting room, at periods varying from four or five to fourteen days; the most usual time being about seven days.

(21.) The heat of the cheese-room is unknown to ten. Of the three others, one states it to be kept at 60°, another generally at the same, except during the day in summer when it reached 68°, and a third at from 45° to 55°, varying according to the out-door temperature. *All* appear to aim at having the cheese-room "moderately warm."

(22.) Artificial means for heating the cheese-room in cold weather were adopted only by three, who used hot air, derived either from the kitchen grate, or from a stove kept for the purpose. The cheese-rooms in most instances being over the kitchen or dairy, are thereby kept what is considered sufficiently warm.

(23.) The cheese is usually ready for the market in three or four months after being made. One person (Mr. Beresford) says he has frequently sold a lot, the youngest of which would not be more than six weeks old, but that his cheese would keep sound and good for twelve months or more.

(24.) Twelve used annatto for colouring, seven in the *solid* or cake form, and five in a *liquid* form; but one has now discontinued its use, considering it pernicious. The weight used of the *cake* is only given correctly by three: one using 1 lb. to 23 cwt. of cheese, and two others using only ½ lb. to a ton. The liquid used by one is stated to be one-fifth of a gill to a 60-lb. cheese, and by another two tablespoonsful to an 80-lb. cheese.

(25.) Few answers are given to the final request that the candidates would "state any other particular;" from them I extract the two following:—

"Cleanliness is very essential, and perseverance with punctuality in every process from the time of milking the cows until the cheese is ready for market."—J. Gresty.

"I am of opinion no given rule (alone) will make a *good* dairymaid, there are so many variations. She must have tact and great caution or the dairy will vary in flavour and quality."—C. Beresford.

I have now briefly to refer to the twenty-three returns from unsuccessful competitors. Their replies correspond in many respects with those of the thirteen successful ones, but afford stronger proof, if any be still wanting, of the unsystematic manner in which cheese is manufactured in Cheshire, and of the necessity for inquiry on the part of farmers and their wives, *whether more fixed rules and principles than those at present adopted are not necessary in order to insure success.*

Although the trouble of testing the heat of the milk by a thermometer at the time of mixing for coagulation is so trifling, and the test itself so much superior to that of the fingers' ends, yet it appears that so many as thirteen out of these twenty-three did not adopt it, and amongst those who did, very great disagreement exists,—some giving the heat as low as 66° and 68°, and others as high as 90°;—the proper heat being, according to my own observations, about 80°, or ranging from 75° to 80°.

As to the *salt applied to the curd*, the application of which so materially affects the flavour of the cheese, only three out of the twenty-three makers can give any account of the quantity they use; one says 1 lb. of salt to 20 lbs. of curd; another $\frac{3}{4}$ lb. to a 60-lb. cheese; and a third says: "The salt was not weighed. The salting in a great measure depends on the *time* of the year, the nature of the food, or the luxuriance of the herbage: when the cheeses now exhibited were made [October, 1857], *perhaps* more than the average quantity of salt was used, say $2\frac{1}{2}$ lbs. to a 60-lb. cheese." On referring to my private notes as to the opinion of the judges on these cheeses, I find the remark "*too salt*," at which those who know anything about cheese-making will not be surprised. If the result of my former investigations on this point are of any value, the quantity used was nearly double what it ought to be, and was indeed exactly double what an experienced dairymaid once informed me she used for a 60-lb. cheese in October.

I have now communicated all the important facts, arising out of the exhibition of cheese at Chester, and I sincerely hope that the Report may have the effect of eliciting further information upon, and inquiry into, that branch of rural economy—alike important both to the producer and the consumer—the manufacture of cheese. We are too much in the habit of considering cheese only as a luxury, whereas it deserves to be considered as much a necessary of life as butcher's meat or potatoes, and perhaps more so. Besides, these have to be cooked, which to the poor man is often a great inconvenience, but cheese requires no preparation, and, *when properly made* and eaten with wholesome bread, is by no means so indigestible as some doctors would make us believe. This remark applies of course to cheese made from new milk, or milk from which little or no cream has been taken, as is the case with *Cheshire;* but even *skim-milk* cheese, though often *hard*, is by no means innutritious.

I am not in possession of an analysis of Cheshire cheese, but I do not suppose it differs materially from that of other so-called *whole-milk* cheese, several kinds of which were analysed some years ago, by Mr. Jones in Professor Johnstone's laboratory; the results of which, as well as that of a skim-milk cheese, I now beg to subjoin, in proof of what I have been stating:—

—	*Double Gloucester Cheese.* Made June, 1845; analysed June, 1846.	*North Wilts Cheese.* Made Sept., 1845; analysed Sept., 1846.	*Dunlop Cheese.* Made 1845; analysed 1846.	*Cheddar Cheese.* Made 1845; analysed 1847.	*Skim-milk Cheese.* Made June, 1845; analysed June, 1846.
Water	35·81	36·34	38·46	36·04	43·82
Caseine	37·96	31·12	25·87	28·98	45·04
Fat	21·97	28·00	31·86	30·40	5·98
Ash	4·25	4·41	3·81	4·58	5·18
	99·99	99·86	100·00	100·00	100·02

It will be seen from the foregoing analyses, that cheese is an exceedingly nutritious substance, standing considerably higher in this respect than butcher's meat. Dividing the constituents into the principal nutritive groups, cheese is composed as follows :—

Flesh-forming substances	31·02
Heat-giving substances	25·30
Mineral matter	4·90
Water	38·78
	100·00*

The farmers of Cheshire during the last twenty years have by means of draining, bone manuring, and other improvements, done as much to increase the produce of their county, as perhaps the farmers of any other county in England, the increase being in numerous instances to my own knowledge not less than 40 or 50 per cent., and in some not less than 100. Let them now turn their attention to *improving the quality of their staple produce*—that of cheese—and they will gain still further credit to themselves and do good service to their country.

I cannot conclude this Report without expressing my approval of the very satisfactory arrangements which were made for the reception and exhibition of the cheese by the Local Committee, and by the General Director of the Show, and without acknowledging the courtesy and attention I received from the then Mayor of Chester (P. S. Humberston, Esq.), and from Mr. Chivas, the Honorary Secretary of the Local Committee, as well as from Mr. Hudson, the Secretary to the Society.

Warrington, November, 1858.

XVII.—*On the Composition and Nutritive Value of Cotton-Cake.* By Augustus Voelcker.

An important addition to our stock of feeding materials has recently been made in the shape of cotton-cake. This cake can

* Morton's 'Cyclopædia of Agriculture,' Art. *Cheese.*

now be bought according to its quality, at from 6*l.* to 8*l.* per ton, and appears to offer considerable economic advantages to the feeder of stock in comparison with other descriptions of cake. Several agriculturists, who have used it in limited quantity, speak favourably of its nutritive properties, but precise comparative feeding experiments are yet required before the practical value of cotton-cake, and its relative merits, in comparison with linseed and other descriptions of cake, can be determined with certainty. To my knowledge it is now being tried on a large scale in various parts of this country, and ere long we may hope to obtain the desired information. We shall then be able to ascertain how far the theoretical value of cotton-cake, as deduced from analysis, corresponds with its practical effects on the system.

This cake is obtained on submitting to strong pressure the oily seeds of the cotton plant (*Gossypium barbadense*), which, as is well known, is cultivated extensively in the southern part of the United States, in India, China, the interior of Africa, and other warm climates.

Cotton-seed yields a dark brown coloured, semi-liquid, and agreeably smelling oil, which, in a purified state, is now used to some extent for the usual purposes for which other kinds of oil and fats are employed. The removal of the dark colour which the oil possesses in a raw state appears to be attended with considerable difficulties, which as yet have only been partially overcome. This perhaps will account for the fact that even now large quantities of cotton-seed are annually thrown aside as useless, or are used to some extent as a manure. However the production of cotton-seed oil has been steadily increasing, and large importations into England of cake, chiefly from St. Louis and New Orleans, have been effected during the past season. It may be confidently expected that the practical difficulties that stand in the way of the purification of the oil will soon be removed, and there can be but little doubt that then a constant and large supply of cotton-cake will be furnished to the English feeder of stock.

The first cargoes of cotton-cake were imported into England some years ago, but the trials of it were not very successful. This need not surprise, for the introduction of every new article into the market is beset with difficulties. Perhaps the partial failures that attended the use of the early shipments of cotton-cake arose from the crude methods of preparing it, and the inferior, half-spoiled state in which it was given to animals. Probably the first cargoes that were brought to England found no immediate purchasers; the cake had to be warehoused for a considerable length of time, during which it got mouldy by damp air, sour, and unpalatable, before it found its way into the feeding stall. Even now some cotton-cake is so mouldy and sour that it is hardly fit to be given to

animals. But there is another reason for the unfavourable opinion entertained by those who tried the practical feeding value of this cake when first imported into England. The albuminous soft kernel of cotton-seed is encased in a hard, dark-coloured shell, composed chiefly of woody fibre, and as the hard shell constitutes a large proportion of the whole seed, and woody fibre possesses little or no feeding value, all the cake that reached this country some years ago being made of the whole seed, was of inferior quality, in comparison with linseed or even rape-cake.

I remember having analysed a sample of cotton-cake of this description four years ago. It contained only $5\frac{1}{2}$ per cent. of oil and more than 30 per cent. of woody fibre.

Such inferior cake is still prepared in the United States as well as in England. The cake, however, made in this country from the whole cotton-seed is, I find, superior to the similarly prepared cake of foreign make.

For the last year or two a very much better article has been sent over from the southern parts of the United States. It is prepared from the shelled or decorticated seed, and is sold at present as decorticated cotton-cake at 7*l.* to 8*l.* per ton, or at about 1*l.* to 30*s.* more than the ordinary cake made of the whole seed. It occurs in commerce in two forms, namely, as thin and as thick cake. The latter, on account of the inconvenience which it presents to the consumer (as it is not readily crushed by ordinary oil-cake crushers), is reduced to a coarse powder by an American firm, who are large importers of both thin and thick decorticated cake. The coarse powder is sent to England in original bags, which are marked "Patent Kiln-dried Oil-meal," and also bear the name and address of the exporter.

We have thus, as far as I know, the following four varieties of cotton-cake offered for sale in the English market:—

1. *Thin decorticated cotton-cake.*
2. *Thick decorticated cake.*
3. *Ordinary cake made of whole seed.*
4. *Oil-meal.*

Having analysed recently samples of each kind, I now beg to lay before the readers of the Journal the results of my examinations, and to accompany the analytical data by a few observations that may assist intending purchasers in selecting for themselves the best description of cotton-cake. No other description of cake is subject to so great variations in composition as cotton-cake. In practical feeding experiments it is therefore most desirable that the composition of the cake should be stated, or at any rate the kind of cake be accurately described.

The following results plainly show that cotton-cake has been sold this year in England which is more than twice as nutritious

and fattening as other samples. Those who have been fortunate enough to secure the best decorticated cake I doubt not will be led by their experience to consider it a most valuable feeding substance, whilst the experience of buyers of inferior cake, made from the whole seed, must lead to a much less favourable practical opinion.

1. Thin Decorticated Cotton-cake.

This cake, as mentioned already, is made from the shelled seed. It has about the same thickness and shape as American linseed-cake, but differs from the latter in outward appearance and in composition. The best decorticated cotton-cake has a light yellow colour, and is free from any strong smell; neither has it any well-defined taste. It shows here and there a few threads of cotton fibre, and contains very little of the dark-brown coloured seed-shells. Mixed with water, in a roughly powdered state, it does not become gelatinous like linseed-cake, nor does it develop any pungent smell under this treatment like rape-cake.

Cotton-cake does not contain any large amount of mucilage, nor anything that produces on mixing with water a volatile, pungent, and injurious essential oil.

Cattle often take at once to it, and even when fed upon linseed-cake they soon get accustomed to the taste of cotton-cake, and apparently eat it as readily as linseed-cake.

In the following Table I have incorporated the results obtained in the analysis of seven samples of decorticated cotton-cake :—

Composition of Decorticated Cotton-cake (Thin Cake).

—	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
Water	7·67	8·27	9·01	10·37	10·01	9·41	10·19
Oil	14·93	19·19	17·93	13·98	17·21	15·64	13·50
* Albuminous compounds (flesh-forming principles)	43·21	42·62	41·81	40·68	40·48	42·75	37·18
Gum, mucilage, sugar, and digestible fibre (heat-producing matters)	14·47	12·25	13·67	18·88	18·09	14·83	22·97
Cellulose (indigestible fibre) ..	11·45	10·12	8·80	9·01	6·67	7·71	8·71
† Mineral matters (ash)	8·27	7·45	8·78	†7·08	7·54	9·66	7·45
	100·00	100·00	100·00	100·00	100·00	100·00	100·00
* Containing nitrogen	6·91	6·82	6·69	6·58	6·47	6·84	5·95
† Containing sand	Not determined.			·68	1·53	Not determined.	·46
,, earthy phosphates	..	..	..	..	..	..	4·27
,, alkaline salts, including phosphoric acid	..	..	..	..	..	..	2·77
	..	..	..	..	..	..	·82

These analytical results suggest the following observations:—

1. The proportion of oil in all the samples analysed is higher than in the best linseed-cake. In the best linseed-cake the percentage of oil rarely amounts to 12 per cent., and 10 per cent. may be taken as a fair average. As a direct supplier of fat, cotton-cake therefore is superior to linseed-cake.

2. The amount of oil in samples sold under the same name is subject to considerable variations. In the oiliest cake, No. 2, there is 19·19 per cent., and in No. 7 only 13·50 per cent. of oil. The greatest difference in these cakes in this respect thus amounts to about $5\frac{1}{2}$ per cent.

3. Decorticated cotton-cake contains a very high and much larger percentage of flesh-forming matters than linseed-cake. This circumstance suggests that cotton-cake may probably be given with great advantage to young stock and to dairy cows. As by far the largest proportion of nitrogen of food is not assimilated in the system, but passes away with the excrements of animals, the dung produced by stock fed upon cotton-cake will be found particularly valuable.

4. In comparison with linseed-cake there is much less mucilage and other respiratory matter in cotton-cake. This deficiency, however, is compensated to a certain degree by the larger amount of oil in cotton-cake.

5. The proportion of indigestible woody fibre in decorticated cotton-cake is small, and not larger than in the best linseed-cake.

6. Lastly, it may be observed that the ash of cotton-cake is rich in bone-materials, and amounts to about the same quantity as that contained in other oil-cakes.

On the whole I am inclined to think, as far as I am able to judge on the strength of the preceding analytical indications, that the best decorticated cotton-cake possesses theoretically about the same nutritive value as linseed-cake. Cotton-cake, of average quality, is probably somewhat inferior to linseed-cake of average composition.

The physical condition of all the cakes, with the exception of No. 4 and No. 7, was excellent. No. 7 was not quite so fresh as the majority of the cakes, whilst No. 4 was decidedly an old badly-kept cake. It was very mouldy, and tasted quite sour, and appeared hardly fit to be given to animals. Cows and sheep refused at first to eat it, but pigs eagerly devoured it. After some time, however, both sheep and fattening cows took to it, and notwithstanding its sour taste and bad condition, I am informed, did well upon it.

I refer here to the condition of cake, because an analysis does not generally indicate whether a cake is new or old, well or badly kept, or otherwise injured. It is important to bear this in mind, for there can be no doubt that animals will thrive better

when fed upon fresh and sweet than upon old, mouldy, or sour cake.

The preceding seven analyses, on calculation, yield the following average numbers, expressive of the *average* composition of thin decorticated cotton-cake :—

Water	9.28
Oil	16·05
* Albuminous compounds (flesh-forming matters)	41·25
Gum, mucilage, sugar, and digestible fibre (heat-producing materials)	16·45
Cellulose (indigestible fibre)	8·92
Mineral matters (ash)	8·05
	100·00
* Containing nitrogen	6·58

2. Decorticated Cotton-cake (*Thick cake*).

This cake is from $2\frac{1}{2}$ to 3 inches thick, but does not otherwise differ materially in its outward appearance from thin cake. It is very hard, and cannot be broken into small bits by ordinary cake-crushers, and for this reason does not command so ready a sale as the thin cake, although it is sold at 10*s.* to 15*s.* less money.

Two samples of thick cake, both imported into Liverpool, yielded on analysis the following results :—

Composition of Decorticated Thick Cotton-cake.

	No. 1.	No. 2.
Water	10·25	9·08
Oil	14·05	19·34
*Albuminous compounds (flesh-forming matters) ..	41·31	43·31
Gum, mucilage, and digestible fibre (heat-producing substances)	18·05	10·48
Indigestible fibre	8·40	10·41
Mineral matters (ash)	7·94	7·38
	100·00	100·00
* Containing nitrogen	6·61	6·93

It will be observed that there is no perceptible difference in the composition of thick and thin cake. In both the thick cakes, being very hard pressed, I expected to find a smaller percentage of oil than they actually contained. I was particularly surprised to find in the second cake quite as high a percentage of oil as that contained in the richest thin cake I have had an opportunity of examining. Fearing a mistake might have occurred in the oil-determination, I had a second determination made, which yielded nearly the same quantity, namely, 19·05 of oil. The oil, extracted by means of ether from thick cake, I observed, presented a darker colour than the oil from the ma-

jority of the thin cakes, which seems to indicate that more heat has been employed in pressing the thick cake.

3. Ordinary Cotton-cake made from the whole Seed.

Cake made of the whole cotton-seed presents a much less inviting appearance than the thin cake; it has a dark-brown colour, is full of hard, dark-coloured seed-shells, is not liked so much by cattle as thin cake, and is altogether a cake of inferior quality.

Some of this cake is prepared in England from imported cotton-seed. The English pressed cake is better than foreign made cake of the same kind. Three samples of this cake furnished on analysis the following results:—

Composition of Ordinary Cotton-cake made of Whole Seed.

—	No. 1.	No. 2.	No. 3.
Moisture	10·53	12·03	11·46
Oil	6·10	6·37	6·07
* Albuminous compounds (flesh-forming principles)	22·62	25·62	22·94
Gum, mucilage, sugar, and digestible fibre (heat-producing compounds)	26·48	29·90	36·52
Indigestible woody fibre	26·96	19·79	16·99
† Mineral matters (ash)	7·31	6·29	6·02
	100·00	100·00	100·00
* Containing nitrogen	3·62	4·10	3·67
† Containing sand	1·76	·91	..
,, earthy phosphates	3·83	..	..
,, alkaline salts	1·72	..	..

On comparing the composition of these cakes with the average composition of decorticated cake it will be seen:—

1. That the proportion of oil in the common cake is very much smaller than in the decorticated cake. The amount of oil is in reality inconsiderable, since most other oil-cakes, such as linseed, rape, poppy, and others, contain a good deal more fatty matter.

2. In decorticated cotton-cake there is a much higher percentage of albuminous compounds.

3. On the other hand, the proportion of indigestible fibre in ordinary cotton-cake is far more considerable than in decorticated cake.

Common cotton-cake is sold at a lower price than the decorticated cake, but, considering the inferior character of the former, its lower price offers little inducement to intending purchasers. A ton of the best decorticated cake, I am inclined to think, is worth quite as much as two tons of the inferior cake made of the

whole seed. I consider the latter dear at the price at which it is sold.

The first sample of the three contained much more woody fibre than the two others. I may observe, however, that the proportion of woody fibre mentioned in the analyses of these cakes does not indicate the amount of seed-shells. What is here called indigestible woody fibre was obtained by treating the cake with cold and boiling water, and subsequently with dilute potash solution and dilute sulphuric acid. By these means the albuminous compounds, pectinous matters, and other constituents of the seed-shells are rendered soluble, and the insoluble residue is conceived to be indigestible cellular fibre.

I have endeavoured, approximately, to determine the proportion of shells in the first cake. As the shells are reduced to powder only with great difficulty, whereas the kernel powders readily enough, the proportion of the former may be ascertained with tolerable accuracy by carefully grinding the cake in a stone mortar, and sifting off the hard shells. Proceeding in this way, I found in No. 1, 58·42 per cent. of shells. This is a great deal more than the average amount of seed-shells in cotton-cake made of the whole seed. It appears to me, therefore, not unlikely that this cake contained an additional quantity of shells beyond that which cotton-seed in its raw state naturally furnishes. In the manufacture of decorticated cake large quantities of shells must be obtained, and it is not unlikely that these shells, with the addition of a little good cake, are pressed into an inferior cake. No. 2 and No. 3 were cakes made in England; they are better cakes than No. 1.

4. Oil-meal.

It has been already mentioned that, on account of the difficulty which the consumer experiences in crushing the thick cake, the manufacturers of this article break up the cake into a coarse powder. This is afterwards kiln-dried, and brought into commerce under the name of patent kiln-dried oil-meal. Two specimens of such oil-meal gave on analysis the following results:—

Composition of Patent Kiln-dried Oil-meal.

	No. 1.	No. 2.
Moisture	9·40	10·21
Oil	17·39	19·71
* Albuminous compounds (flesh-forming matters)	43·81	40·25
Gum, mucilage, sugar, and digestible fibre (heat-producing substances)	11·21	16·38
Indigestible woody fibre	10·44	5·84
Inorganic matters (ash)	7·75	7·61
	100·00	100·00
* Containing nitrogen	7·01	6·44

Oil-meal, if genuine, it thus appears, is identical in composition with the best decorticated cotton-cake.

No. 2, it will be seen, contained nearly 20 per cent. of oil, which is more than I ever found before in any kind of oil-cake.

The process of kiln-drying is resorted to for the purpose of preserving the meal in good condition. It imparts to the cake a peculiar and by no means unpleasant flavour, which is said to be much liked by cattle.

On the whole, oil-meal, when genuine, and of as good a quality as the two specimens analysed by me, presents a handy form of supplying cattle with decorticated cotton-cake; and as it is, moreover, cheaper than the thin cake, its use for feeding purposes is not only more convenient, but likewise more economic, than that of thin cotton-cake.

There is, however, a certain degree of danger in buying a powder, for rubbish of various sorts may be mixed with the meal by unprincipled dealers. But, on the other hand, the respectability of the dealer and chemical analysis afford the means of preventing this species of fraud.

As decorticated cotton-cake is likely to be extensively used for feeding purposes, I have thought it advisable to submit the mineral constituents which it furnishes on burning to a detailed examination.

The following results were obtained in my laboratory by my friend and pupil Mr. Gardner, of Shrewsbury, on analysing the ash prepared from several samples of decorticated cake:—

Average Composition of the Ash of Decorticated Cotton-cake.

Potash	39·045
Soda	none
Chloride of sodium	none
Lime	3·750
Magnesia	13·500
Oxide of iron	1·530
Phosphoric acid	39·649
Sulphuric acid	·930
Carbonic acid	·362
Soluble silica	3·252
Insoluble silicious matter (sand)	17·706
	99·724

Like other oily seeds, cotton-seed contains, it will be seen, a considerable quantity of phosphate of magnesia. In addition to these compounds it contains phosphate of lime and phosphate of potash, and other salts of potash.

The proportion of phosphoric acid in cotton-cake ash is very large, and that of potash likewise is considerable. Soda does not enter into the composition of the ash. For the purpose of

supplying animals with bone-materials, it is a very valuable kind of food.

CONCLUSION.

The principal points of interest, in reference to cotton-cake, are collected together in the following short summary:—

1. The best cotton-cake is richer in oil and albuminous (flesh-forming) compounds than linseed-cake, but contains less mucilage and other respiratory constituents.

2. The mineral portion of cotton-cake resembles closely in composition that of linseed and other oil-cakes. Like the ash of all cakes, it is rich in earthy and alkaline phosphates, and well adapted to supply animals with bone-materials.

3. As far as the indications of chemical analysis can be depended on, the best decorticated cotton-cake possesses about the same nutritive value as linseed-cake.

4. At the present time four distinct kinds of cotton-cake are offered for sale in the market, namely:—

  1. Thin decorticated cotton-cake.
  2. Thick decorticated cake.
  3. Common cake made of the whole seed.
  4. Oil-meal (No. 2 reduced to coarse powder).

5. The thin decorticated cake is a far better and more economic food than the ordinary cake, which is often quite unfit for feeding purposes.

6. Thick cake scarcely differs in composition from thin cake, but being hard, and $2\frac{1}{2}$ to 3 inches thick, it cannot be crushed by an ordinary oil-cake crusher, and therefore presents inconvenience to the consumer.

7. Genuine oil-meal is simply thick decorticated cake reduced to a coarse powder, and of course has the same composition as the cake from which it is made.

8. The composition, and with it the nutritive value, of different samples of cotton-cake is subject to considerable variation.

9. Decorticated cotton-cake and oil-meal, in comparison with other kinds of artificial food, are decidedly cheap feeding materials, and both, no doubt, ere long, will find that favour with the British farmer which a really valuable and cheap article of consumption is certain to command.

After the foregoing pages were in type, I received a note from Mr. John Fryer, Manor House, Chatteris, enclosing a sample of cotton-cake, and giving a short account of the death of a bullock that had been fed upon the cake and upon mangolds, barley-

meal, and clover-hay. Mr. Fryer enclosed the following report of the veterinary surgeon:—

"*Surgeon's Post-mortem Examination.*

"Internal and external appearance healthy, nothing inflammatory. Paunch enormously distended with food. The manifold (I speak as butchers speak) crammed and jammed full of substance like tough dough rolled hard and adhering to the folds. Lower stomach quite empty. The duodenum, for 24 inches in length, entirely blocked up with two or more pounds of the irregular-shapen concave and comminuted husks. Upon comparing them microscopically with the cake before eaten, they were found to be identical."

This report leaves no doubt about the cause of death. The distension of the first bowels was evidently caused by cotton-husks, which, I am informed, were pressed so tightly into the bowel as to give externally the appearance of stones.

On examining Mr. Fryer's cotton-cake, I found it to contain more than half its weight of cotton-husk. I am inclined to think that this cake was prepared by pressing the refuse from the manufacture of decorticated cotton-cake with a small quantity of cotton-seed.

Cakes similar to that forwarded by Mr. Fryer have been lately sent to me for examination. I am glad to have reported them unfit for feeding purposes, having suspected the hard husks of common cotton-cake as likely to do harm. Mr. Fryer's case shows that my suspicion was not altogether imaginary, and confirms the opinion expressed above respecting the feeding value of ordinary cotton-cake.

Royal Agricultural College, Cirencester,
December, 1858.

XVIII.—*Directions for Working Portable Steam-Engines, and keeping them in Proper Order.* By Messrs. Ransome and Sims.

Respected Friend, *Ipswich, December*, 1858.

Referring to thy request to us on this subject, we now have the pleasure to hand thee some directions which we have prepared in reference to the management of Agricultural Steam-Engines. It is especially desirable that they should not only be observed by the engine-man, but be studied by the proprietor and employers. Hoping that we may have carried out thy view,

We are thine respectfully,

Ransomes and Sims.

H. S. Thompson, Kirby Hall, York.

Preparing Engine for Work.

Place the engine as nearly dead-level as possible, and in such a position that the dust caused by thrashing may not be blown upon it. The wheels should all have an even bearing on the ground, so as to prevent any rocking motion when at work.

Filling the Boiler.

Care should be taken to procure water as clean as possible for the use of the engine; water from ponds or ditches, into which the drainage of the farmyard is taken, should be avoided. The water must be poured into the boiler through the opening provided for that purpose (by means of the iron funnel furnished with the engine) till it appears about half way up the glass gauge tube.

Glass Water-Gauge Apparatus.

The water-gauge cocks should always be tried before the fire is lighted, to ascertain that there is no obstruction in the passages, which would prevent the water finding its proper level in the glass tube. In case the water does not appear to move freely in the tube, on opening the small cock at the bottom of the gauge, take out the two screws opposite the passages to the boiler, and insert a wire through the holes into the boiler, till the water issues freely; the screw-plugs may then be put in again, and the fire lighted. Great care should be taken to prevent either of the cocks between the boiler and the glass tube becoming shut when the fire is burning and the steam up.

Use of Gauge-Cocks.

It is possible that the glass gauge may become choked up when the engine is at work, so that it cannot be cleaned out without letting down the steam; if the water does not appear to move freely in the glass tube, the small cock at the bottom of the gauge must be opened, so as to let the steam and water blow out of the gauge; if it is then evident that the gauge is choked, the gauge-cocks must be used to ascertain the height of the water in the boiler: the bottom one should discharge water only, and the top one steam; the level of the water in the boiler being somewhere between the two gauge-cocks.

Lighting the Fire.

The fire-bars must be well cleaned from dirt and clinkers before the fire is laid; a few dry shavings and a small quantity of firewood should then be spread over the bars, and some small coal scattered over them; a light may then be applied to the shavings from beneath the grate bars, and the fire will soon burn briskly; with some fuel it is better to place the fire-door a little

way open till the coal is ignited; coal may then be put on in small quantities at a time, the fire-bars being kept covered to a depth not exceeding three inches; the fire must be clear, but the bars must not be allowed to become bare of coal in places, for the cold air will then pass through the tubes and check the formation of steam; all wet straw and damp wood should be avoided for lighting the fire. As soon as the fire is lighted a few pails of water should be poured into the ash-pan; it tends to prevent the formation of clinkers, and greatly preserves the fire-bars by keeping them cool; it also decreases the danger of fire in the stack-yard, because all the hot cinders, as they fall from the grate, are instantly extinguished; if the weather be very windy, it may be necessary to close one of the doors of the ash-pan, and to open the other; experience will soon point out which door should be closed.

Raising Steam.

The fire, as it burns up, should be kept thin and bright; the coal must never be heaped up against the tubes; too much coal should not be thrown on at a time, or it will tend to delay the production of steam; a careful engine-man will soon find out the best mode of firing with the different descriptions of coal he will be required to use.

Brushing out Tubes.

If the coal is bad, or of a kind which emits a large quantity of smoke, the tubes should be well brushed out during the dinner hour; this can easily be done without dropping the fire, by allowing it to burn low, and raking it into one corner of the grate. The tubes may be easily brushed out from the smoke-box end. Before commencing to light the fire in the morning, the tubes must always be well brushed out.

Safety-Valve and Spring-Balance.

As soon as the water begins to boil, the safety-valve should be opened by hand and examined, to make sure that it is not obstructed in any way; the spring-balance may then be screwed down to about 10 lb., and when the steam blows off at that point it may be gradually screwed down to 45 or 50 lb. as the steam rises. The spring-balance should on no account be left always screwed down to the full pressure when the engine is not at work, and the steam not up, because the elasticity of the spring is thus destroyed; and it is very possible, if the engine remains long out of use, that the valve may become set fast, which would cause danger when the steam was next got up.

Oiling the Engine.

Before starting put a little oil into the cylinder through the

cock provided for the purpose, and move the engine round by hand, by means of the fly-wheel, to ascertain that it is all in working condition; all the oil-cups must be filled up, and the syphon-wicks examined, to make sure of their being in good condition. A little oil should be put upon the guide-bars themselves, as well as into the oil-cups attached to them; the pump-plunger, and all the eccentrics, must also be oiled.

Starting and working the Engine.

The piston should be placed at about the half-stroke, and the regulator-valve opened gradually, the two relief-cocks on the cylinder being previously opened: after the engine has made a few revolutions these cocks may be shut, and the regulator-valve set full open, so that the speed of the engine may be controlled by the governors. The feed-pump should be tried as soon as the engine is in motion, to ascertain that it is in working condition, before the water has had time to diminish. To set the pump to work the suction-cock may be opened, and the small pet-cock must also be opened and shut a few times; if water does not issue from the pet-cock at every stroke of the plunger, the finger should be applied so as to stop the hole in the pet-cock for a few strokes, and then be taken off it again; this operation should be so performed that the hole in the cock may be closed by the finger on the plunger going out of the barrel of the pump, and opened on the return stroke when the plunger is forced in again. If, after repeated trials, no water is thrown by the pump, and steam or hot water only issues from the cock, something is wrong with the valves, and they must be carefully examined.

Pump out of order, Valves to be examined.

The engine must be stopped, the cock connecting the feed-pipe to the boiler must be shut, the covers of either or both valves may then be taken off, and the valves examined or cleaned; the engine must on no account be moved round after the valve covers are put on again, before the cock, connecting the feed-pipe to the boiler, be opened, or the pump and pipes may be seriously damaged. The use of this cock is to enable the pump-valves to be examined when the steam is up, without the danger of scalding those about the engine.

Supply of Water to Boiler.

It is desirable to have a constant supply of water always going into the boiler from the feed-pump; a little experience will soon point out to the engine-man how far the cock requires to be open to enable him to do this; the plan of shutting the feed quite off for some time, and then turning it full on, should never be

adopted, for by this means the formation of steam is rendered irregular, and much fuel wasted.

Mode of Firing.

The fire must be kept constantly bright and clear; the bars must be covered, but never more than three inches thick; and the coals must not be heaped up against the mouths of the tubes; coal must be put on the fire in small quantities, and frequently, and not all at once, and then allow the fire to burn quite low; experience will show how often the fire must be supplied with coal, as it much depends upon the quality of the coal and the amount of work that the engine is doing.

Water low in Boiler.

There should never be less than two inches of water visible in the glass gauge-tube when the engine is at work; if, by accident or neglect, the water should become so low as only to show about half an inch in the glass tube, the fire should instantly be dropped; by lifting the fire-bars from their places by means of the tools furnished for the purpose, the burning coals will fall into the water in the ash-pan, and be extinguished; water should never be thrown into the fire-box to put out the fire—it is apt to scald those who do so, and to injure the fire-box; the fire must on no account be again lighted until the boiler has been filled up.

Bearings to be oiled and examined when Engine is at work.

The bearings and guide-bars should be carefully examined from time to time to see that they are properly supplied with oil from the lubricators attached to them; it is a good plan to put a little extra oil upon the guide-bars, in addition to filling the lubricators upon them. Whenever the engine is stopped, all the bearings should be felt, to make sure that they have not heated; if there be any disposition to heat, the bearings having such a tendency may be loosened a little, but they must not be too slack, or it will occasion a disagreeable knocking, which is very injurious; sometimes it becomes necessary to take the top brasses quite off to free them from grit, which will cause heating in the brasses; the parts requiring most attention are the two ends of the connecting rod, and the bearings of the crank-shaft; the eccentrics also should be oiled occasionally when the engine is working; the brass rings should be slackened a little if they become warm; after taking the cap off a bearing, care must be taken that, on replacing it, it is not screwed down too tightly, or it will be sure to cause friction, and increase the mischief sought to be avoided.

Preparations for Moving the Engine.

When the day's work is over, and the engine is going to be moved to another place, the water should be run out of the boiler when the steam is quite down; the practice of blowing all the water out of the boiler directly the fire is dropped is a very bad one, for the sudden contraction of the tubes caused by the rapid cooling makes them leaky, and does much mischief: the boiler should never be refilled when hot; for the same reason the water should never be left in the boiler when the engine is going to travel over a hard road; if it is merely going to be moved on soft ground for a short distance, no harm will be done beyond adding greatly to the weight; care should be taken that the fire-bars do not shake out, and thus be lost, when the engine is travelling.

Governor Balls.

It is a good plan to take the levers carrying the balls off when the engine is going to travel, as the jolting on roads is very apt to break these levers; they may be carried conveniently in the smoke-box, wrapped up in hay or shavings to prevent injury.

Road Wheels to be occasionally examined.

Before the engine travels any great distance the road wheels should be taken off, and the axles examined and cleaned. If the axles are much cut they should be dressed over with a smooth file to take off all roughness; they should be well greased with a mixture of oil and melted tallow before going on a journey; and if the journey be long, the small screws in the naves of the wheels should be occasionally taken out, and fresh oil be poured into the axle-boxes.

Cleaning Engine.

After the day's work is done the engine should be well rubbed over with cotton waste, and all dust and grit should be removed, also all superfluous oil which may have accumulated during working; the chimney should be lowered down, and the engine be covered over with the tarpauling furnished for that purpose; the engine should always be carefully covered up when travelling, to prevent the working parts from becoming injured by dust or mud.

Washing out Boiler.

The boiler must be well washed out and cleansed after about twelve or fourteen days' working; to do this the brass plugs and mud-doors round the bottom of the outside shell of the fire-box must be taken out; water must be poured freely into the boiler through the opening where water is poured in, the mud and scales being at the same time loosened and pulled out with a

small iron rod, the end of which should be made like a hoe; at the same time the plug beneath the tubes in the smoke-box should be taken out, and the man-hole cover be lifted off, a long rod being pushed backwards and forwards through the hole under the tubes, so as to loosen the dirt and sediment. Water should be poured into the man-hole plentifully, so as to wash out all that may be collected in the boiler through the various mud-holes, which should all be open during this operation. On again putting in the brass plugs, be careful not to cross the threads; they must be entered with the fingers only, and not screwed up with the spanner until they have been screwed in several turns by hand.

Preparing the Engine for lying out of Work for a considerable time.

If the engine is not going to be used for some length of time (say a month), the cylinder-cover should be taken off, and the cylinder well rubbed dry and oiled; the fly-wheel should then be turned round a few times by hand, to ensure every part of the piston and slide becoming well covered with oil; the cylinder-cover may then be put on again; the joint only requires a little red-lead cement to be spread around it; but the red-lead must not be so placed as to squeeze into the cylinder itself when the cover is screwed up: care must be taken to screw the bolts up very equally. The whole of the bright work of the engine must be well dressed over with a mixture of white-lead and hot tallow, put on with a painter's brush. The packings from the piston-rod, slide-rod, and pump-plunger should be taken out, for they injure the rods by causing corrosion to take place from the moisture of the hemp packing.

Packing the Engine.

This operation cannot easily be described, and must be seen to be comprehended thoroughly; the engine-man who is sent from the works with the engine will instruct the person who is about to take charge of the engine how to do the packing, and many other things which require practice to do properly. None but the best white spun-yarn and white hemp must be used for packing, and it must be quite free from all gritty particles. The packing, before being put into the stuffing-boxes, must be well soaked in hot tallow.

Oil for Engine.

Neatsfoot or sperm-oil should be used; but if this cannot be procured, olive-oil will answer the purpose. Hot tallow should never be poured into the cylinder, for much dirt is thereby introduced, which will cut and injure the piston and cylinder.

General Remarks.

The more care and attention the engine receives the longer it will work without extensive repairs. Very frequently great damage is done, and heavy expense incurred, through the carelessness and ignorance of the person who acts as engine-man; no person should be sent out to work these engines who has not had previous experience with high-pressure engines of some kind. Wood should never be used as a fuel when the engine is at work, on account of the great quantity of ignited pieces blown out of the top of the tunnel by the steam-blast; the foolish and dangerous practice of carrying hot coals in shovels from the farm-house to the engine in the stack-yard for the purpose of lighting the fire should never be allowed. All tools and spanners must always be kept in the tool-box with the engine ready for use, and everything should be kept clean and in its place.

Small Repairs.

The parts that will require repairing most frequently are the brasses of the connecting-rod and crank-shaft; the guide-bars also occasionally require adjusting; but all these things should be done by an engineer who is accustomed to the work; and the file and chisel must never be used by the engine-man, or more harm than good will be done.

XIX.—*On the Cost of Horse-power.* By J. C. Morton.

The management of farm horses, including the cost of various methods of feeding them, has already been discussed in the pages of this Journal. In the 5th and 9th volumes especially the subject occupied a prominent place—Mr. Burke and Mr. Spooner, both of them excellent authorities, there stating the results of their experience and intelligence. A good deal of information has also been given incidentally in the county reports which have appeared from time to time in the later volumes of the series.

That the subject has not, however, been exhausted is plain from the frequent and continued discussion of it at the meetings of local farmers' clubs, and from the attempts of writers in every new systematic work on agriculture to throw some additional light upon it. The cost of horse-power is, moreover, a subject of particular interest just now when steam-power, in its various agricultural uses, is being declared the cheaper of the two; and it is worth while in the first place to consider their relative positions. Prizes have been awarded at the recent annual

meeting of the Society for methods of using the latter in field cultivation, which are alleged to be an economical substitute for the horse-drawn plough. I use the word "alleged" instead of "proved," not to dispute what seems to me the unquestionable justice of the award, but to suggest the need of some further explanation of it. The cost of the competing steam-power on the occasion of the trial was fully analysed and specified. It was stated in the official report, under the heads—Engineer, Plough and Anchor Men, Boys, Water-cart, Coals, Oil, and Interest on Capital; while that of the competing horse-power was merely estimated. It was "estimated" that the light land could not have been so well ploughed by horses under 8*s.* an acre, nor the heavy land under 12*s.* 6*d.* It would have been more satisfactory had this estimate been justified by a detailed analysis instead of being merely declared; for it is not too much to say that while under one man's management the cost of horse culture might have been as much as 10*s.* an acre, under another it would not have been 7*s.* 6*d.* Steam cultivation will, no doubt, ultimately be adopted, altogether irrespectively of narrow differences of cost per acre: it will lead to deeper and more thorough tillage, to greater economy of time, to greater promptitude, activity, and skill in labourers; and these are sufficient security for its adoption and extension, whether it cost a shilling more or a shilling less per acre than the present ordinary system of farm management. But it is plain that a decision of the narrow question of immediate cheapness cannot be made by comparison of actual cost on one side with mere "estimate" upon the other. Professor John Wilson, one of the judges to whom the Chester award is due, has indeed since declared as much in a lecture on this subject to students of agriculture in the Edinburgh University. He has stated, what is obviously true, that no decisive comparison is possible until we have ascertained the actual cost of each per cwt. of draught at a given rate of movement.

The object of the present paper is to give the materials of such a calculation, as they are furnished by the experience of some of the best farmers in the country. Certainly, at present, the statement of the agriculturist on the one side of the subject is most indefinite and vague when compared with that of the engineer upon the other. The latter gives the result of his observations and his calculations to the third place of decimals;* the former is too often content with an unsupported declaration of opinion. The farmer, no doubt, has to deal with more inconstant and indefinite particulars than the mechanic;

* See vol. xvi. pp. 509, 510.

but his experience can be recorded with equal accuracy, and, when extended over a sufficient length of time, will furnish data for as detailed a calculation.

But an attempt to define more accurately the experience of the agriculturist on this subject would be useful independently of its enabling a just comparison of the cost of horse-power with that of steam. It would tend to the more general adoption of the best methods of horse management. Something of the kind has, indeed, already happened. Thus, in the earlier days of the competition in agricultural steam-engines, their differences of cost per unit of the power produced exceeded 100 per cent. Their consumption of coal per horse for every such unit thus produced varied at Carlisle from 3·698 up to 10. At Chester, after three years' competition, most of them had much more nearly approached the best upon the list. Now, the earliest allusion in this Journal to the cost of horse-labour is in the first of those admirable pictures of English agriculture (vol. i.) drawn by Mr. Pusey. He there stated (p. 19), on the authority of the Harleston farmers' club, that amongst a body of farmers all residing within four or five miles of that place, all using a similar breed of horses, and all cultivating a similar description of land, a difference in the expense of maintaining their cart-horses existed, amounting in authenticated statements to upwards of 50 per cent., whether estimated at per head for each cart-horse, or per acre for the arable land. It is impossible with systems of general management, as it is with methods of constructing and of feeding steam-engines, to bring the influence of public and immediate competition to bear on their improvement; but some of the effects of this competition may, perhaps, be produced by the mere publication of existing differences; and whether or not these differences are now as great as they were at Harleston twenty years ago, at any rate the publication now attempted of some of the methods prevalent in this country of managing the horses of the farm must have a useful tendency.

The materials before me for such a comparison as thus appears desirable consist of—1. The published estimates of such men as Professor Low in his works on Agriculture and Landed Property, Henry Stephens in his 'Book of the Farm,' and Robert Baker in the last edition of Bayldon's 'Art of Valuing Rents and Tillage.'

2. The published discussions of this subject before the Highland and Agricultural Society (Feb. 1850), the London Farmers' Club (June 1850, April 1853), the Botley, Darlington, Gloucester, Harleston, Newcastle, Witham, and other farmers' clubs, at various times.

3. The published practice and experience of various individual agriculturists given in the first volume of this Journal—in Bacon's

Report of Norfolk—in the first volume of the Journal of the Bath and West of England Agricultural Society—and in the pages of the agricultural papers during the past few years. For the student of this subject I may refer, in addition to all this, to the formal treatises on the Horse and on Stable Management by Stewart, Youatt, and several anonymous writers, whose pages, however, I have not consulted.

4. Lastly, about two dozen reports of their own practice and experience kindly sent to me by gentlemen farming in Kent, Sussex, Dorsetshire, Gloucestershire, Oxfordshire, Berkshire, Essex, Bedfordshire, Lincolnshire, Nottinghamshire, Northumberland, the Lothians, Invernessshire, and near Dublin and Waterford.

In order to use this great mass of evidence in as compendious and clear a manner as possible for the illustration of the subject, it is proposed in the first place to give a list (Table I.) of all the various plans of feeding followed, giving the authority for each—stating the quantities consumed and the calculated cost per week—and classifying them according to the season of their use. In a second table (II.) a selection of these plans is made so as to embrace the whole twelve months in each of the instances selected, and thus bring out the cost per horse per annum. The annual cost of horse-food in a number of authenticated cases will thus appear. In a third table (III.) I give in as condensed a form as possible the further history of those cases which have been sufficiently described in the reports which have been given to me. To the cost of food there is here added the estimated or the stated amount of blacksmiths', saddlers', and farriers' bills, and of keeping up the value of the animal and the implements he uses: here also is given the number of horses worked, and from this the total annual cost of the horse-power of the farm is calculated: to this is added the wages annually paid the ploughman, deducting, when I was so instructed, such portion as is due for work at harvest and other times unconnected with the horses. With the whole annual cost of horse labour at which we thus arrive, the reader of this table may compare the acreage of the several crops whose annual cultivation is accomplished in the several cases specified; and notes are given in the several instances to characterize the kind of soil prevalent on the different farms. The remainder of the paper is occupied with extracts from the reports with which I have been favoured, and with an attempt to deduce, from a few of the histories given in the tables, the cost of horse-power "per cwt. of draught at a given rate of movement."

The first table, it will be seen, gives in successive columns the number of each case, the authority on which it is given, the

weight consumed per week of hay, oats, beans, roots, clover, and straw by a horse, and the calculated weekly cost of so maintaining it. This cost is calculated at the rates of 3*s.* a cwt. for hay, 3*s.* a bushel for oats, 5*s.* a bushel for beans, 4*d.* a cwt. for turnips or mangold-wurzel, 6*d.* a cwt. for carrots and clover, and without charge for straw. I do not attempt any justification of the prices here adopted. They will suffice as well as any others to illustrate the mode of calculation adopted; and no figures could be substituted for them to which exception might not somewhere be justly taken.* The prices adopted in calculating the cost of food are, it will be found, the ordinary market prices of the *grain* consumed; and, in the cases of the *hay* and *green food*, the value which it is supposed they might produce if given to other kinds of live stock on the farm. Where an *asterisk* (*) is attached to any item it is to be understood that the corn has been bruised or ground, or the hay or straw has been cut into chaff: where a *dagger* (†) is appended the article so marked has been boiled or steamed: a mark of interrogation (?) indicates that the result so marked is uncertain owing to some indefiniteness in the account given. The cost of stable management, apart from that merely of the food, does not appear in this table; it will appear in Table III. under the head of Wages paid to Team-men.

There are no fewer than 115 cases named in Table I. (p. 442). If any of the methods of feeding here described should seem whimsical—any of their differences merely fanciful—the excuse which must be taken for their appearance is, that not one of them is imaginary, not one of them is a mere scheme or proposal—every one is actually adopted and in use on farms, many of them in whole districts, in this country.

The differences of cost in the weekly food, according to the modes of feeding specified in Table I., are very considerable; more than 100 per cent. in the cost of summer feeding, which averages 8*s.* a week and varies from 5*s.* to 11*s.*; 70 or 80 per cent. in the cases given of autumn feeding, which costs on the average about 9*s.* 6*d.*, and varies from 7*s.* 6*d.* to 12*s.*; more than 100 per cent. in the cost of winter feeding, which averages about 6*s.* 4*d.*, varying from 4*s.* 9*d.* to 12*s.*; and 30 per cent. in the

* It must be understood that the cost of weekly keep, which, in upwards of one hundred cases, is given in Table I., can be taken only for an approximation to the truth. It is difficult to state correctly the actual expense of food grown upon the farm; and there are several instances of apparent discrepancy, or seeming error, in calculation, of which the explanation or justification which I should offer might not by every one be considered satisfactory. Some of these it will be found are owing to 6*d.* per cwt. being charged for clover cut and carried to the yard; while 5*s.* a-week is charged for the keep of a horse wholly at grass in the field; and 2*s.* per week is charged for grass, in addition to other food, when the horse is turned out to the field after work.

TABLE I.—THE WEEKLY FOOD OF A FARM-HORSE.

No.	Name and Address.	Hay.	Oats.	Beans.	Roots.	Clover.	Pasture.	Weekly Cost.	
	THE SUMMER SEASON.	lbs.	lbs.	lbs.	lbs.	lbs.		s.	d.
1	———	..	..	..	..	..	ad lib.	5	0
2	Professor Low—Elements of Agriculture ..	..	35	..	..	1,400	..	8	2
3	H. Stephens—Book of Farm (and others) ..	..	..	..	..	ad lib.	Night.	7	6?
4	J. Gibson, Woolmet—H. Soc., 1850	..	50	..	..	5s. 3d.	..	9	0
5	— Binnie, Seton ditto	..	70	28	..	ad lib.	Night.	11	0?
6	Ditto ditto	..	50	..	..	ad lib.	Night.	8	0?
7	— Thomson, Hangingside ditto	..	84	..	..	ad lib.	..	9	6
8	— Barthropp, London F. Club, 1853	..	20	80	..	2s.	..	9	9
9	Ditto ditto	..	..	48	..	3s.	..	6	9
10	J. Morton, Whitfield Farm, 1843	..	70	..	..	784	..	8	9
11	Mr. C. quoted at Gloucester F. Club, 1843 ..	..	80	..	..	5s.	..	11	0
12	W. Gater, Botley F. Club	..	..	16	Bran. 2 bus.	ad lib.	..	8	0?
13	W. C. Spooner, Journ., vol ix., p. 274	..	42	..	..	5s.	..	8	0
14	J. Twynam, Botley F. Club	..	42	..	..	$2\frac{3}{4}$ rods	..	5	9
15	T. Baldwin, Glasnevin	..	35	..	..	700	..	6	0
16	J. Coleman, Royal Agr. College, Cirencester	..	42	..	..	ad lib.	..	6	6
17	J. Cobban, Whitfield	..	42*	..	..	ad lib.	Night.	6	9?
18	E. W. Moore, Coleshill	..	63	32	..	ad lib.	Night.	10	6?
19	Ditto ditto	..	63	..	..	ad lib.	Night.	8	0?
20	S. Rich, Didmarton, Gloucestershire	84*	$31\frac{1}{2}$	..	..	1s.	2 acres.	7	6?
21	F. Sowerby, Aylesby, N. Lincolnshire	..	..	28	..	..	ad lib.	6	0?
	THE AUTUMN SEASON.								
22	Professor Low—Elements of Agriculture ..	140	70	..	..	..	..	9	0
23	Ditto ditto ..	140	50	..	Potat. 70†	..	..	7	6?
24	W. Gater, Botley F. Club	168	63*	32*	..	..	..	12	0
25	W. C. Spooner, Journ., vol ix., p. 274	112	84	24	..	..	..	11	0

26	T. Aitken, Spalding, Lincolnshire	..	37½	..	..	ad lib.	..	7	6 ?
27	Ditto ditto	..	37½	35	..	ad lib.	..	10	0 ?
28	T. P. Dods, Hexham	..	105	..	..	..	ad lib.	10	6 ?
29	Ditto ditto	ad lib.	105	..	..	..	..	10	6 ?
30	A. S. Ruston, Isle of Ely	ad lib. ½.	77	10	Bran. ⅓ bu.	..	Straw. ad lib. ½	9	0 ?
31	A. Simpson, Beauly, N. B.	168	70	14	..	..	24 lbs.	10	0
32	H. J. Wilson, Mansfield	..	52½	..	..	ad lib.	..	7	3 ?
33	Ditto ditto	42	87½	..	Bran. 21 lbs.	..	ad lib.	9	0
	The Winter Season.								
34	Professor Low—Elements of Agriculture ..	..	70	..	..	..	Straw. ad lib.	5	3
35	Ditto ditto ..	..	50	..	Potats. 70†	..	..	4	9
36	Ditto ditto ..	56*	56*	..	56†	..	56*	6	6
37	H. Stephens—Book of the Farm	..	70	..	Turnips. 112	..	70	5	7
38	Ditto ditto	112	35	..	112	..	..	6	0
39	Ditto ditto	..	56	..	77†	Potats. ..	105*	4	6
40	J. Gibson, Woolmet—H. Soc., 1850	..	84	..	217†	217†	112*	9	0
41	— Binnie, Seton ditto	..	70*	28*	243†	Barley. 42†	ad lib.	11	6
42	— Steedman, Boghall ditto	..	70	..	500	Lins. 3½	ad lib.	7	6
43	— Thomson, Hangingside ditto	..	84	14	336	Barley. 14	ad lib.	9	6
44	— Black, Dalkeith ditto	112	84*	..	196†	..	..	10	0
45	— Barthropp—London F. Club, 1853	112	21	80	224	..	..	11	8
46	Ditto ditto ..	112	..	48	224	..	..	7	6
47	Mr. C. quoted by Mr. N., Gloucester F. Club	..	84	..	..	Carrots. 784	..	9	6
48	J. Morton, Whitfield Farm	..	126	..	..	350	ad lib.	10	9
49	W. Gater, Bottley F. Club	..	..	32*	70	Pollards. 40	ad lib.	5	6
50	J. Twynam, ditto	112	63	16	..	..	..	8	9

TABLE I.—THE WEEKLY FOOD OF A FARM-HORSE—*continued.*

No.	Name and Address.	Hay.	Oats.	Beans.	Roots.	Clover.	Straw.	Weekly Cost.	
	THE WINTER SEASON.—*continued.*	lbs.	lbs.	lbs.	lbs.	lbs.		s.	d.
51	—. Trotter, Darlington F. Club, 1845	ad lib.	84	64	..	..	..	14	0 ?
52	Ditto ditto	..	73	Cut Oat Sheaf.		..	110	5	3
53	W. C. Spooner, Agricultural Gazette, 1845 ..	28	63	16	112	..	28	7	0
54	H. Briggs, Overton, ditto ..	140	110	..	..	..	..	11	6
55	Ditto ditto ..	294	..	..	..	..	..	7	6
56	Ditto ditto ..	..	..	64*	..	Linseed. 3½	140	6	6
57	Quoted by Bacon—Agriculture of Norfolk ..	56*	42	28*	..	..	..	7	0
58	Ditto ditto ..	75	42	21	..	..	..	6	8
59	Ditto ditto ..	75	..	64*	a few.	..	..	7	6
60	Ditto ditto ..	112	42	25	..	Bran. 16	..	9	6
61	Ditto ditto ..	112	84	...	..	..	ad lib.*	10	0
62	Bartliever Farm—Journ., vol. vi. p. 454 ..	..	84	..	112	..	70*	7	0
63	Ditto ditto ..	112	42	..	112	..	..	7	0
64	R. Smith, Bath & W. of Eng. Soc. Jour., vol. i.	147	73½	..	..	..	..	9	3
65	Ditto ditto ..	98	37	28	..	..	49*	8	0
66	Ditto ditto ..	70	..	56	..	Bran. 49	70*	9	6
67	Ditto ditto ..	140	56	..	49	..	..	8	3
68	Ditto ditto ..	70	..	..	56	Tail Corn. 49	70*	5	6
69	Ditto ditto ..	98	98	..	..	..	49	9	9
70	Ditto ditto ..	24*	37	..	..	Linseed. 14	140	5	3
71	Ditto ditto ..	84	44	49	..	Grains. 140	..	12	0
72	Ditto ditto ..	154	..	..	..	Grown Barley. 84	..	9	0
73	Ditto ditto ..	49	..	37	..	Linseed. 7	98*	5	0
74	Ditto ditto ..	70	..	70	..	..	70*	7	3

75	Ditto ditto ..	49	..	35	Potatoes. 70	Grains. 42	49*	6	0
76	Ditto ditto ..	140	..	..	Turnips. 84	Tail Corn. 63	..	8	0
77	Ditto ditto ..	70	52	..	..	Oil-Cake. 28	70*	8	3
78	Ditto ditto ..	70	37	21	280	..	..	7	6
79	Ditto ditto ..	..	73	..	280	..	112*	6	3
80	W. C. Spooner, Journal, vol. ix. p. 274 ..	..	63	..	42	..	196	4	9
81	T. Aitken, Spalding, Lincolnshire	ad lib. ⅔.	37½	35	..	..	ad lib. ⅓.	9	0
82	G. W. Baker, Woburn, Bedfordshire	ditto	60*	20*	..	..	ditto	9	6
83	R. Baker, Writtle, Essex	70	42	..	..	..	140	5	0
84	,, ...	70	73	..	..	..	140	7	3
85	J. Coleman, Ag. College, Cirencester	..	84	16	..	..	ad lib.	7	3
86	T. P. Dods, Hexham	..	95*	..	56	..	ad lib.	8	0
87	T. Baldwin, Glasnevin	210	70*	..	Carrots or Bran. 49	42†	..	11	6?
88	J. Cobban, Whitfield	84*	60*	..	Linseed. 3½†	..	ad lib.*	7	3
89	S. Druce, jun., Ensham	112	52½	..	Swedes. 70	..	2 bu.*	7	0
90	C. Howard, Biddenham	ad lib. ⅔.	52½	17½	84	..	ad lib. ⅓*	8	6?
91	J. Laidlaw, Frampton-on-Severn	..	84	..	..	Carrots. 336	ad lib.	7	6
92	I. J. Mechi, Tiptree	49*	70*	..	M. wurzel. 210	..	ad lib.*	7	6
93	D. A. Milward, Waterford	35*	49*	..	Turnips. 280†	Gorse. 1464*	35*	7	0?
94	W. J. Pope, Bridport	2*	84	..	..	..	ad lib.	9	0?
95	S. Rich, Didmarton, Gloucestershire	168	63	..	..	Grains. 2 bu.	ad lib.	10	8
96	A. S. Ruston, Isle of Ely	ad lib. ½*	77	..	..	..	ad lib.*	8	0?
97	H. E. Sadler, Lavant, Sussex	140	84	..	..	..	..	9	9
98	M. Sandford, Dover	56	42	..	Carrots. 80	Bran. 28	ad lib.	5	6
99	A. Simpson, Beauly, N. B.	..	49	7	105†	Tail Corn. 21	ad lib.*	5	6

TABLE I.—THE WEEKLY FOOD OF A FARM-HORSE—*continued.*

No.	Name and Address.	Hay.	Oats.	Beans.	Roots.	Clover.	Straw.	Weekly Cost.	
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	*s.*	*d.*
	THE WINTER SEASON—*continued.*								
100	H. J. Wilson, Mansfield	42	52½	..	..	Bran. 21	ad lib.	6	6 ?
101	F. Sowerby, Aylesby, N. Lincolnshire	..	105	28	..	Oilcake. 7	ad lib.*	10	6
	THE SPRING SEASON.								
102	Professor Low—Elements of Agriculture ..	140	73	..	..	Potatoes. 70†	..	9	9
103	Ditto ditto ..	140	105	..	..	..	..	12	0
104	— Binnie, Seton—H. Soc. 1850	84	70	..	500†	Linseed. 3½	ad lib.	9	9
105	W. Gater, Botley F. Club	168	..	32*	..	Pollard. 2½ bu.	..	8	6
106	J. Twynam ditto	112	84	16	..	..	..	10	3
107	R. Baker, Writtle, Essex	70	70	30	..	..	140	9	0
108	T. P. Dods, Hexham	ad lib.	120*	..	..	..	..	10	6 ?
109	T. Baldwin, Glasnevin	147	98	..	Carrots. 49	..	..	11	6
110	C. Howard, Biddenham	ad lib. ½	42	..	Green Rye. ad lib. ½*	..	..	7	6 ?
111	D. A. Milward, Waterford	63*	70	..	Turnips. 280	..	63*	8	0
112	A. S. Ruston, Isle of Ely	ad lib. ½*	84	..	Green Rye. ad lib. ½*	..	..	10	0 ?
113	A. Simpson, Beauly, N. B.	168	70	14	..	..	24	10	0
114	H. T. Wilson, Mansfield	42	87½	Oilcake. 7	Carrots. 21	Bran. 21	ad lib.*	8	6
115	E. W. Moore, Coleshill	112	63	..	..	..	ad lib.*	10	0

cost of spring feeding, which averages nearly 10*s.* a week, varying from 7*s.* 6*d.* to 12*s.*

I find that the average cost per week of keeping a horse throughout the year, according to the cases here described, and putting the summer season down as lasting 18 weeks, the autumn 6 weeks, the spring 12 weeks, and the winter 16 weeks, amounts to about 8*s.* weekly. The annual cost in some of the cases named is, however, brought out more accurately in the following table, where the average annual cost of 35 selected instances comes out as equal to 21*l.* 15*s.*, being about 8*s.* 4*d.* weekly throughout the year.

Table II. (p. 448) consists of a column giving the number of the statement; a column naming the person whose management is being described; columns for the months of the year containing under each month, or part of month, the number of the dietary in Table I. which is being then in use; and a money column containing the sum to which the weekly dietaries specified in the several months amount in each case in the course of the year.

It is plain that these two tables need to be studied and compared rather than merely read; and the reader must be, for the most part, left to gather in this way the information they convey; for it would take more pages than can be spared to state in words the facts of these three dozen histories which are here compendiously expressed in figures. One or two remarks, however, may be allowed. Thus the discrepancy ought to be pointed out which exists between the annual cost of horse-keep as calculated from the detailed statements of one or two authorities, and the cost as calculated from the quantities estimated by the same authorities as being consumed during the year. Professor Low's weekly dietary costs 21*l.* a-year, while his statement of quantities consumed in the course of the year comes to 28*l.* 15*s.* per annum—compare No. 1 with No. 31: and so with the reports of Mr. Baker of Writtle (12 and 33) and Mr. Mechi of Tiptree (20 and 35). As to the relative values of the differing statements, it will, I think, be safer to accept the calculated results of the given weekly consumption than to trust to the estimated annual quantities consumed. Some of the differences (amounting to 25 or more per cent.) may be owing to different rates of valuation having been adopted in the two cases respectively.

The main point, however, to which attention will be given in this table is the large difference of annual cost per head incurred under different modes of management in the maintenance of the horses of the farm. Mr. Sandford pays 16*l.* 6*s.* per head per annum; Mr. Melvin pays 30*l.* 16*s.*, nearly twice as much. One must not too confidently infer from such a difference per head a similar difference in the cost of horse-labour *per*

TABLE II.—THE ANNUAL FOOD OF A FARM-HORSE.

No.	Authority.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Annual Cost. £. s. d.
1	Professor Low	35	102	102	103	103	2	2	2	2	22	34	35	21 0 0
2	—— Binnie	41	41	41	41		5	6	6	6	41	41	41	30 10 0
3	W. Thomson	43	43	43	43	43	43	7	7	7	43	43	43	24 14 0
4	—— Barthropp	46	46	45	45	45	8	9	9	45	45	45	46	24 10 0
5	Mr. N., Gloucester	47	47	47	47	47	11	11	11	11	47	47	47	25 0 0
6	J. Morton	48	48	48	48	48	10	10	10	10	48	48	48	25 10 0
7	W. Gater	49	49	49	105	105	105	12	12	12	24	24	24	22 2 0
8	J. Twynam	50	106	106	106	13	13	13	13	13	13	50	50	19 16 0
9	W. C. Spooner	80	80	25	25	25	25	14	14	14	25	25	80	22 12 0
10	T. Aitken	81	81	81	81	81		3	3	26	27	81	81	22 11 0
11	G. W. Baker	82	82	82	82	82		3	3	82	82	82	82	24 0 0?
12	R. Baker	83	84	84	107	107	16	16	16	16	107	107	83	18 14 0?
13	J. Coleman	85	85	85	85	85	16	16	16		85	85	85	18 5 0
14	T. P. Dods	86		108	108	108	28	3	3	28	28	29	86	24 5 0
15	T. Baldwin	87	87	109	109	109	109	15	15	15	87	87	87	26 6 0
16	J. Cobban	88	88	88	88	88	17	17	17	17		88	88	18 7 0
17	S. Druce, jun.	89	89	89	89	89	17	17	17	17		89	89	18 0 0
18	C. Howard	90	90	90	90	110	100		1	1	90	90	90	19 6 0?

TABLE II.—THE ANNUAL FOOD OF A FARM-HORSE—*continued.*

No.	Authority.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Annual Cost.
														£. s. d.
19	J. Laidlaw	91	91	91	91	91	7	7	7	7	91	91	91	23 16 0
20	I. J. Mechi	92	92	92	92	92	3	3	3	92	92	92	92	19 10 0
21	D. A. Milward	93	93	111	111	10	10	10	3	3	93	93	93	20 0 0
22	E. W. Moore	115	115	115	115		18	18	19	18	18		115	26 3 0
23	W. Pope	94	94	94	94	3	3	3	3	3	94	94	94	20 17 0
24	S. Rich	95	95	95	95		20	20	20	20	20	95	95	24 2 0
25	A. S. Ruston	96	96	96	96		112	1	1	1	30	30	30	19 11 0?
26	H. E. Sadler	97	97	97	103		16	16	16		103	103	97	23 15 0
27	M. Sandford	98	98	98	98		3	3	3	3	98	98	98	16 6 0
28	A. Simpson	99	99	99		30	3	3	3	3	..	31	99	19 2 0
29	F. Sowerby	101	101	101	101	101	101	21	21	21	21	101	101	23 14 0
30	H. J. Wilson	100	100	114	114	114	7		3	32	33	33	100	21 13 0
31	Professor Low	Oats 125 bush.; hay $26\frac{3}{4}$ cwt.; green food, clover, &c., 6*l.*												28 15 0
32	J. Melvin	Oats 132 bush.; bran 5 cwt.; barley 24 bush.; grass 3 tons; turnips 3 tons; pasture at night, 3 months												30 16 0
33	R. Baker	Oats 64 bush.; hay 40 cwt.; grass, &c., 7 tons; beans 20 bush.												24 2 0
34	J. Gibson	Oats 85 bush.; turnips 58 cwt.; potatoes 58 cwt.; grass, &c., 22 weeks, at 5/3 ..												22 17 6
35	I. J. Mechi	Oats 68 bush.; grass, &c., $\frac{1}{2}$ acre; red clover $2\frac{1}{2}$ acres; hay 2 tons												30 4 0

acre. The less expensive method is not necessarily the cheaper of the two, as these very farms sufficiently illustrate. In Mr. Sandford's case 12 horses are used (consuming, therefore, 195*l.* 12*s.* worth of food, or 16*s.* 3*d.* per acre) in cultivating 240 acres of "a marl on a chalk subsoil, from 6 to 7 inches deep." That it is well done may be inferred from the good crops grown last year, reaching 44 bushels of wheat over 60 acres, and 50 bushels of barley over a similar extent. In Mr. Melvin's case 20 horses are employed (consuming, therefore, 616*l.* worth of food per annum, or about 18*s.* 4*d.* per acre) in cultivating 675 imperial acres, "part of it 8 to 11 inches deep, the rest say 7 or 8—the lea furrow being 6 inches deep." But the difference between 30*l.* 16*s.* and 16*l.* 6*s.* (90 per cent.) does not merely dwindle down to one between 18*s.* 4*d.* and 16*s.* 3*d.* per acre (7 per cent.); it becomes a difference upon the other side when considered in connection with the quantity and laboriousness of the fallow crops in the two cases respectively. But this will more plainly appear in the columns of Table III., where the other items going to swell the cost of horse-labour—namely, wages of team-men, farrier's and tradesmen's bills, annual cost of keeping up implements and animals—are enumerated, and where the number of horses kept and the extent of the different crops cultivated by them is given for comparison. My reference now to the two extreme cases in Table II. is merely to guard against the idea that the cheapest management of horses necessarily implies the cheapest production of horse-power.

It is no part of my purpose in this paper to justify or condemn any of the methods of horse management here described, still less to recommend any other method not referred to here; my object simply is to describe existing practice, and ascertain in a number of instances the cost of horse-labour per acre or of horse-power per cwt. Yet I may allude to some of the instances given in Table II. as agreeing remarkably in their cost per annum, all of them being adopted by excellent practical farmers, and illustrating what seems to me an economical and yet efficient style of management. I refer to Nos. 13, 16, and 17, by Messrs. Coleman, Cobban, and Druce, where the annual cost of a horse is little more than 18*l.*, or 1*s.* a-day, each pair working 14 to 16 acres of fallow crops annually.

Let us now turn to Table III. (p. 451). The first column gives the number in Table II. of each of the cases, 21 in number, selected from the reports I have received. A reference to these numbers will at once identify the names of those on whose authority the particulars are given. We have next (2) the annual cost of food per horse taken from Table II.; (3) the estimated or the actual amount, given under the head of extras, of blacksmith's,

TABLE III.—VALUATION OF HORSE-LABOUR.

1. Number in Table II.	2. Annual Cost per Horse. Food.	3. Annual Cost per Horse. Extras.	4. Number of Horses.	5. Total.	6. Annual wear of Implements.	7. Wages of Team-men.	8. Total Cost of Horse-labour.	9. Acreage. Pasture.	10. Acreage. Arable.	11. Acreage. Fallow Crops.	12. Acreage. Grain Crops.	13. Acreage. Clover, &c.	14. Acreage. Pulse, &c.	15. Cost per Acre of Horse-labour over the Arable Land.	16. Cost per Acre of Horse-labour over the Ploughed Land.
	£. s.	£. s.		£. s.	£. s	£. s.	£. s.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	£. s. d.	£. s. d.
10	22 11	4 10	20	541 0	32 0	300 0	873 0	..	660	110	330	110	110	1 6 6	1 11 9
11	24 0	5 10	20	590 0	70 0	332 0	992 0	400	560	140	280	140	..	1 15 5	2 7 2*
13	18 5	5 10	11	261 5	40 0	170 0	471 5	43	400	91	182	85	42	1 3 6	1 10 0
14	24 5	5 0	8	234 0	31 0	176 0	441 0	110	310	78	155	57	20	1 8 5	1 14 10
15	26 6	5 10	5	159 0	12 16	85 0	256 16	41	128	32	54	37	5	2 0 0	2 16 5
16	18 7	5 10	7	166 19	20 0	104 0	290 19	400	200	50	100	50	..	1 9 0	1 18 9*
17	18 0	5 10	7	164 10	20 0	116 0	300 10	100	200	50	100	50	..	1 10 0	2 0 0
18	19 6	4 10	12	285 12	33 0	170 0	488 12	120	330	77	175	68	10	1 10 6	1 17 4
19	23 16	5 0	7	201 12	25 0	120 0	346 12	60	250	63	125	42	20	1 7 9	1 14 3
21	20 0	5 10	12	306 0	30 0	132 12	468 12	..	300	75	150	75	..	1 11 3	2 1 9
22	26 3	5 10	11	348 3	34 0	179 8	561 11	400	340	90	150	45	55	1 13 0	1 18 1*
23	20 17	5 10	14	368 18	40 0	200 0?	608 18	400	400	120	185	80	15	1 10 6	1 18 0*
24	24 2	5 10	12	355 4	40 16	170 0?	566 0	274	408	60	174	174	...	1 7 9	2 0 0*
25	19 11	4 10	29	697 9	90 0	364 0	1151 9	120	900	235	450	150	65	1 5 7	1 10 8
26	23 15	6 5	16	480 0	50 0	219 15	749 15	75	500	120	240	140	..	1 10 0	2 1 8
27	16 6	5 10	12	261 12	24 0	158 4	443 16	6	240	50	120	60	10	1 17 0	2 10 3
28	19 2	5 10	10	246 0	30 0	150 0	426 0	..	300	100	150	50	..	1 8 4	1 14 0
29	23 14	5 10	22	642 8	60 0	291 4	993 12	..	600	150	300	150	..	1 11 0	2 4 2
30	21 13	5 10	20	543 0	90 0	348 16	981 16	..	900	200	340	340	20	1 1 10	1 15 0
32	30 16	5 10	20	726 0	67 10	338 0	1131 10	..	675	125	300	200	50	1 13 6	2 7 8
6	25 10	8 0	7	234 10	30 0	117 0	381 10	..	240	60	120	30	30	1 11 9	1 16 4

* The instances marked with an *asterisk* are those of pasture farms as well as arable. From 3*s.* to 4*s.* 6*d.* per acre for horse-labour on the pasture should be deducted from the sums in column 8; and the remainder, spread over the arable land of the farm, will give figures more correct for columns 15 and 16. For example, No. 11: Mr. Baker, of Woburn, whose pasture land costs him 4*s.* 6*d.* an acre for horse-labour, would thus have the figures 35*s.* 5*d.* and 47*s.* 2*d.* in columns 15 and 16 reduced to 32*s.* and 40*s.* respectively.

saddler's, farrier's bill per horse, together with the cost of maintaining the value of the animal undepreciated; (4) the number of horses worked upon the farm; (5) the total cost of horse-keep on the farm, as made up of food and "extras;" (6) the cost of maintaining the implements in use at an undepreciated value—viz. (except where I have been particularly instructed), 10 per cent. upon an estimated expenditure of 1*l*. per acre of the arable land; (7) the amount of wages paid to team-men, as calculated from the particulars supplied to me, and explained in sundry notes extracted from these reports; (8) the total cost of horse-labour on the farm; (9 and 10) the total acreage of the farm in arable and pasture land; (11, 12, 13, and 14) the acreage of the several crops cultivated on the arable land,—fallow and fallow crops including bare fallow, turnips, carrots, mangold-wurzel, cabbage, &c.; grain, including wheat, barley, oats, &c.; clover, including clover, sainfoin, lucerne, &c.; and pulse, &c., including beans, peas, and flax—the labour of cultivation given to this last crop being considered equal to that given to beans or peas. Lastly, we have (15 and 16) the cost of the horse-labour of the farm per acre of the arable land, and per acre of the actually ploughed land—*i. e.* excluding clovers, &c., as well as permanent pastures. I must, however, direct attention to the foot-note appended to the table, which points out the influence of the pasture land upon the accuracy of these figures.

I must not attempt here to *read* through all this table in detail, so as to point out the information it contains: some words of explanation will, however, be permitted me. Column 3 contains the amount of annual depreciation per horse, together with the cost of blacksmith's, saddler's, and farrier's bills. The sum stated is generally an estimate, but upon a very commonly allowed scale. The horse is valued at 30*l*., and the estimated annual loss of value is 10 per cent., which will provide for the renewal of the stock at a sufficiently short interval of time. To this 3*l*. there is added 10*s*. a-year for the farrier, 10*s*. a-year for the saddler, and 30*s*. a-year for the blacksmith—these all being sums I have known contracts to be founded on. In many of the reports which I received, the value of the horse is stated, but either in so vague a way (as, for instance, "from 15*l*. to 45*l*."), or with such limitations as to time (as, for instance, "if you had asked me last year I should have stated 36*l*. instead of 26*l*."), that it was better, so I thought, to assume a common value for them all. One of the cases in which the actual fact, and not mere estimate, is stated in this column, is that of my father's farm at Whitfield, Gloucestershire. I have the accounts of that farm for four of the earlier years of his occupation, during which 9 horses

were employed; and the following are the figures under the heads of Saddler, Smith, and Farrier respectively:—

Year.	Saddler.			Smith.			Farrier.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
1844..	8	8	6	44	3	1½	1	15	0
1845..	4	5	0	24	13	6½	3	0	0
1846..	7	2	3	30	6	10	4	15	6
1847..	4	1	0	26	7	10	3	6	8
Total .. ÷ 4	23	16	9	125	11	4	12	17	2
Average per annum ÷ 9	5	19	2	31	7	10	3	4	3½
Average per horse.. ..	0	13	3	3	7	6	0	7	2

The sum of these three items, here brought out as the annual cost of the horses, is 4*l.* 7*s.* 11*d.* per head; and the value of the horse being considerably upwards of 30*l.*, their annual depreciation added will make the total at least 8*l.* per head per annum; but this, it must be remembered, includes all smith's work on the implements as well.

The other figures in column 3 are explained and justified in the following notes, extracted from the reports received:—

(10.) "Since I joined my father in my present occupation in 1841 I have the accounts of horses purchased; and as our practice has been to buy only for making up our team, and, with only one exception, at an age to be put to work immediately bought, so that nothing is chargeable to keeping, and I consider our present team superior to what I commenced with, it is, I think, a very fair criterion. The cost of farriers will lead you to suppose we have been tolerably healthy, and it includes attendance on cattle, and I believe nearly half should be charged to cattle account.

"Our blacksmith's bills include work done to machinery and fencing, &c., which does not properly belong to horse-labour.

"Our shoeing will be very much less than in most localities. [It is a fen soil.]

"The saddler's account, you will see, is in excess: it includes harness for gig and riding.

"The implements are far below your estimate, though I think mine are in good order, and fully capable of well working our occupation. I have not employed either a wheelwright or blacksmith on the premises, so that all my expenditure has come in bills, and it is very easily ascertained. Our total expenditure for seventeen years is as follows:—

	Horses.			Farrier.			Blacksmith.			Saddler.			Implements.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
	678	18	0	50	12	0	370	15	7	244	13	9	550	15	0
Average per annum, say	40	0	0	3	0	0	22	0	0	14	10	0	32	0	0

"The extras you charge 5*l.* 10*s.* would in our case, reckoning for 20 horses, only amount to 4*l.*; that is 2*l.* per horse for depreciation, 3*s.* for farrier, 1*l.* 2*s.* blacksmith, 15*s.* saddler. On further consideration I should be inclined to put the charge for extras at 4*l.* 10*s.* per horse."

(14.) "My smith's account, including cast-iron shares for the plough, has

not averaged 16*l*. per annum; and my carpenter's account from 5*l*. to 6*l*. annually. The farrier's bill does not exceed 2*l*. per annum, and the saddler costs 5*l*. a year. These sums divided by 8, the number of horses [and deducting for work on implements], amount to 2*l*. Ten per cent. on 30*l*., the value of the horses, makes the sum in my case 5*l*. instead of 5*l*. 10*s*."

(17.) "I contract with a blacksmith to shoe my horses at 10*s*. per horse per year, and a similar sum to the harness-maker. I think a deduction should be made for the pasture land; the expenses on the grass portion of my farm amount, I find, to about 3*s*. per acre annually."

(18.) Mr. Howard contracts for the shoeing of his horses at 11*s*. each. The charge of 30*s*. is in his case too high, but it includes smith's work on repair of implements. He also keeps a pair of extra job-horses, used in busy times: all which must be borne in mind when considering the accuracy of the above figures in his case.

(19.) "I believe I can say what few of your correspondents can say, that 1*l*. per horse will cover our farrier's bill for all the 17 years we have been farming. I attribute this in great measure to a uniform system of feeding."

(25.) "I put out my shoeing for 11*l*. a year—29 work-horses and generally 3 nags. On our fen soils shoes wear out slowly."

(29.) "Your estimate of extras approximates very near to what I see mine cost. The following is the amount of my extras for the last four years:—

	Saddler.			Blacksmith's Contract.			Farrier's Contract.		
	£.	*s*.	*d*.	£.	*s*.	*d*.	£.	*s*.	*d*.
1855	19	7	0	36	0	0	7	0	0
1856	14	4	6	36	0	0	7	0	0
1857	12	0	0	36	0	0	9	0	0
1858	15	12	0	36	0	0	7	0	0
	61	3	6	144	0	0	30	0	0
Per annum	15	5	10	36	0	0	7	10	0
Per horse ÷ 22 ..	0	13	10½	1	12	9	0	6	10

	£.	*s*.	*d*.
Amount in all	2	13	5½
Add for annual depreciation	3	0	0
Total amount	5	13	5½

to which you are sufficiently near."

(30.) "The actual shoeing of 20 horses for 11 months has been 14*l*. 4*s*. 8*d*., which for 12 months would give 15*l*. 10*s*. 6*d*. per annum, or 15*s*. for a horse annually. For the same 12 months the cost of replacing the merely 'wearing parts' of ploughs, harrows, &c., has been about 25*l*., which I believe is below the average. This is a pretty good illustration of the character of our soil. Our farrier costs us 18*l*. a year, of which 10*l*. may belong to the horses, costing 10*s*. yearly each."

(32.) "We reckon the annual depreciation in value on a 30*l*. horse at 3*l*. and of course 4*l*. 10*s*. on a 45*l*. horse. The smith's accounts come to 3*l*. 10*s*. per pair for maintaining everything belonging to or wrought by the horses, but not furnishing anything new. The saddler's account costs from 15*s*. to 1*l*. 15*s*. per horse, according to the style and keeping of harness. Insurance per horse amounts to 1*l*. on a 30*l*. horse; and my experience, where horses are fully fed and hard wrought, declares it to cost that sum. My farrier's account does not reach 5*s*. per horse."

The above notes are sufficiently explanatory of the figures in column 3. The number of horses used is the subject of column 4, and in column 5 I have multiplied this number into the cost per horse of food and extras, so as to give the total in every case of the merely personal expenses (so to speak) of the animals. Column 6 contains the annual cost of implements, calculated in general at 2*s.* an acre of the arable land. It is a common thing to put the implements of the farm at 1*l.* per acre, and this is 10 per cent. upon that sum; but the implements used by the horses, which alone ought here to be considered, do not cost so much as this; I have, however, retained the 2*s.* per acre; for, though 10 per cent. upon horse implements may not be so much, yet carpenter's and blacksmith's bills, and annual depreciation in spite of them, will, I feel sure, require fully that amount. In Mr. Baker's edition of Bayldon's 'Art of Valuation' the implements enumerated as properly chargeable on horse-labour reach the sum of 27*l.* per horse—little more than 11 per cent. on which is 6*l.* 8*s.* per pair; and this over the average number of arable acres, namely 64 to a pair of horses (according to the instances enumerated in Table III.), is just the 2*s.* per acre at which I have estimated their tear and wear. In the last case upon the list I have not put down so large a sum, because the blacksmith's bill in column 3 in that case includes most of the repairs of implements, and, excepting carts, few of them are wood—30*l.* a-year would, therefore, cover carpenter's bill and depreciation. In the first case also I was instructed to reduce the amount.

Column 6, which includes wages of team-men, needs a detailed explanation, which accordingly I give by extracts from the reports received—the numbers prefixed to the paragraphs corresponding to the numbers in Tables II. and III.:—

(10.) "We are giving our ploughmen 12*s.* per week at the present time, with house and garden free; 20*s.* a-week for four weeks in harvest, and 20 bushels of potatoes. Last year we gave 13*s.* 6*d.*, and the year before 13*s.* Taking an average of years, I suppose it would be barely 12*s.*"

The account here, therefore, stands thus:—

	£.	*s.*	*d.*
10 ploughmen, at 12*s.*, for 48 weeks	268	0	0
Ditto at 20*s.*, for 4 weeks	40	0	0
200 bushels potatoes, at 2*s.* 6*d.*	25	0	0
Cottages and gardens, say	40	0	0
	£373	0	0
I am instructed to deduct for harvest-money and sundry employment ..	73	0	0
Charged against the horses	£300	0	0

I give the calculations in this case in detail, but the reader must be left to work it out for himself in the other instances:—

(11.) "The ploughmen now are paid 2*s.* a-day. Of course their wages fluctuate according to the price of provisions. They generally get an advance of 2*s.* per week for four weeks during haymaking, and they are paid 20*s.* a-week for a month during the corn harvest; and they have the privilege of working by contract whenever opportunity offers during hay-time or harvest. It will not, therefore, be fair at such times to charge the whole of their wages to the cost of horsekeeping."

(13.) "Three of the ploughmen are paid 11*s.* a-week, and receive 36*s.* extra for harvest. Two boys get 7*s.* a-week, and about 15*s.* extra for harvest work. No beer or extras of any kind beyond the wages. The carters groom but do not feed their horses: a regular horse-feeder is kept, who employs about half his time at this work, and is paid 12*s.* per week, and 32*s.* extra for harvest work."

(14.) "The general wage of a full ploughman has been for the last few years 15*s.* or 16*s.* a-week, with from 2 to 4 bushels of wheat, the same of barley, 80 stones of potatoes, and a house free, and cartage of coals. He is bound to supply a woman-worker at 1*s.* a-day in summer, 1*s.* 6*d.* in harvest, and 10*d.* in winter. Some men get less and some few more than this: my own wages are 15*s.*, with the lesser quantities of corn."

(15.) "The ploughman's wage is 12*s.* a-week, with a free house."

(16.) "We pay our ploughman 10*s.* a-week—extra in harvest."

(17.) "The wages of the ploughmen are from 12*s.* to 14*s.* a-week."

(18.) "My horsekeeper's wage is 12*s.* a-week; my under ditto and ploughmen from 8*s.* to 10*s.*, with double wages for the harvest month."

(19.) "The wages of the ploughmen are above the common rate of the neighbourhood: they receive 11*s.* 6*d.* in money, besides beer and extra money in harvest, also a house and garden worth 5*l.* a-year."

(21.) "Ploughmen get 8*s.* 6*d.* a-week."

(22.) "Carters 15*s.* a-week (no perquisites). Young men and boys hired by the year, from 5*s.* to 9*s.* a-week."

(23.) "One man and boy are allowed to a team of four horses. The ploughmen's wages are from 8*s.* to 9*s.* per week, with house, garden, fuel, and 20 perches of potato ground, and 1*s.* for every journey above six miles from the farm."

(24.) "Carters' wages 15*s.* a-week, including rent, fuel, beer, and indulgences." (Boys' wages not stated.)

(25.) "We have no hiring of servants, but our ploughmen are ordinary labourers, taking the ordinary wages—just now 10*s.* per week; when corn is dearer, 12*s.* a-week."

(26.) "The wage of the ploughman is usually 1*s.* a-week and a house rent-free more than the ordinary labourer. For 4 weeks during harvest they have double wages. Their wages for the year, including rent of house, would amount to 35*l.* *now.*"

(27.) "The waggoners have 2*s.* a-week more than the labourers, who are now paid 11*s.* a-week. The second man has 1*s.* less than the waggoner, and both have 2*l.* 10*s.* for harvest. The 'all-works' have 10*s.* per week all the year round. The boys have 7*s.* per week for board, and 6*l.* wages." (Four horses to a team.)

(28.) "The ploughmen are engaged by the year, and the money wages, with allowance of provisions (valued at wholesale prices), amount to 30*l.* per annum, besides a cottage on the farm."

(29.) "Ploughmen about 12*s.* a-week."

(30.) "Ploughmen's wages 15*s.* to 17*s.* a-week, except for a month in harvest."

(32.) "Ploughmen's wages may amount in all to 13*s.* per week, varying from 12*s.* 9*d.* to 14*s.* 3*d.* according to price of grain, namely,—house, 21*l.*, 1050 lbs. of oatmeal, 8 cwt. of potatoes, cartage of coals, and food for 4 weeks in harvest-time."

(6.) "Head-ploughman 13*s.*, the others 12*s.*, boy 6*s.* a-week."

I give these extracts as not only throwing light on the construction of column 6 in Table III., but also as being very interesting in themselves.

Columns 1, 2, 3, 5, 6, and 7, give us the means of calculating the total cost of horse-labour, which accordingly appears in column 8.

In columns 9 and 10 we have the acreage occupied by the tenants in the several cases specified. Of course it would be of little service to compare the total cost of horse-labour with the total acreage, because much of it might be pasture, involving little labour of the kind. The extent of arable land is accordingly given, and the cost of horse-labour is calculated in column 15 per acre of the arable land in every case. But even this would mislead without further explanation, and accordingly in columns 11, 12, 13, and 14, will be found the acres respectively in fallow and fallow crops, in grain crops, pulse, and clover. And in column 16 the cost of horse-labour per acre ploughed that year is calculated. But even these particulars are insufficient to enable a perfectly truthful comparison, for the soil may be stiff or light, and the cultivation may be deep or shallow.

Take, for instance, one of the last cases (30) in the above table. Mr. Wilson's farm is an extremely light sand, just enclosed out of the heathy waste of Sherwood forest. He cultivates it generally 5 to 7 inches deep, excepting one deep ploughing in preparation for turnips, which is about 10 inches deep; and yet a day's work at plough varies from 1 acre of deep work, to $1\frac{1}{2}$ or even more of light fallow ploughing. The average of all sorts will be at least $1\frac{1}{4}$ acre done daily per pair of horses in 8 or 9 hours. No wonder that Mr. Wilson's horse-labour costs less per acre than the others, whatever his method of stable feeding may be; for heavy land cannot, of course, be cultivated for the same expenditure as light and sandy soil. In order, then, that the figures of these last columns of Table III. may be read intelligently, I add another series of extracts from the reports, stating the ordinary depth of cultivation adopted in the several cases, and the character of the soil. The figures numbering the paragraphs are the same as those of Tables II. and III.:—

(10.) "The soil is peat upon clay, over say one-half of the farm; over the remainder the clay is ploughed up, and it needs a great deal of rolling to give

it sufficient solidity for the wheat crop. The ploughing may be averaged for a pair of horses to do $1\frac{1}{4}$ acre daily. The general depth of cultivation is 5 inches; for, though we plough deeper for fallow, yet the peat decomposes, and we lose the depth in the course of a year, and we find it prejudicial to any other crop to plough deeper than it was fallowed."

(11.) "About 100 acres are strong land, but not so retentive as to prevent its being ploughed ordinarily with 2 or 3 horses. The remainder (460 acres) is a sandy soil. It has all usually been cultivated from 5 to 6 inches deep."

(13.) "Two hundred and sixty acres are a useful marl with stones; the soil deep enough to allow of 7-inch ploughing, and sufficiently retentive (often containing 50 or 60 per cent. of clay) to render it stiff working land in moist weather. One hundred acres are of a light and shallower soil, sometimes occupying the slopes of the hills, where we may not have more than 2 inches of earth. Forty acres are a strong clay marl. Three horses in line are needed for 6 to 7-inch ploughing. From 1 acre (lea ploughing) to $\frac{5}{4}$ (in winter) is a day's ploughing."

(14.) "Except 70 acres of strong soil, part of which is very steep, my farm is flat alluvial soil, partly light and partly good deep loam—all good turnip land. Fallows are ploughed 8 to 9 inches deep with 2 horses, 12 to 13 with 3 horses whenever the land allows; lea land is ploughed 6 to $6\frac{1}{2}$ inches deep; turnip land for corn 5 inches."

(15.) "The soil is a loamy clay, of a darkish brown colour, resting on the middle limestone formation."

(16.) "Of the soil, 20 acres are light and shallow, resting on limestone rock; 100 are a lightish sandy loam; and 80 are a clayey loam. We plough a foot deep for roots, 4 inches deep for corn."

(17.) "The character of the land is gravel, clay, and clay loam. Our ordinary depth of cultivation is from 5 to 8 inches—never less than the former. The ordinary day's work varies from 3 roods to an acre, the horses working double."

(18.) "The character of the soil over 230 acres is gravel, liable in a dry time to burn; over 100 acres a black gravel and loam. For wheat we plough 4 to 5 inches deep; for barley 4 inches; our turnip fallows from 8 to 9 inches. We usually expect a man with a pair in ordinary work to do his acre in the day, excepting the fallows, which are laid up for the winter with 4 horses in a plough, and in spring, when these fallows are ploughed back, with a 3-horse plough."

(19.) "The soil over most of the farm is a gravel, and on the rest a stiff clay. We plough 6 or 7 inches deep, except for roots, when the furrow is 10 or 12 inches deep."

(21.) "We use 2-horse swing-ploughs, and 3 roods to an acre are a day's work; on short days, of course, we must be satisfied with less."

(22.) "We have a deep loam on the west side of the farm, and can plough safely and usefully 9 or 10 inches; on the south side we have a strong loam on clay, the average depth being 6 or 8 inches; on the east side a very useful stonebrash, cultivated 6 inches deep; on the north side it is pasture. The ordinary extent of a day's work at plough is an acre; 3 horses ploughing for beans and fallow in the autumn, 2 being used for all else after the first spring furrow."

(23.) "The soil varies much, and in a dry summer is very difficult to work. It is cultivated from 4 to 6 inches deep. Three horses are used in a plough for 'breaking' grass and heavy stubble, and 2 only for the after-ploughings. From 3 roods to 1 acre is about a usual day's work for one plough."

(24.) "Soil chiefly a light stonebrash, like most of the Cotswold district; but there are some sand and some clay spots. It is cultivated 4 to 5 inches deep, or more when the soil admits. Half an acre, or rather less, is a day's

work, taking the average of dry and wet with the distance from the stables. Generally 2, sometimes 3 horses are used in a plough."

(25.) "The soil on the fen farms is very light and non-adhesive; on the high lands more tenacious and heavy. Many fen farmers break up a good deal of their clean fallow lands with 4 or 6 horses in a large plough, bringing up the subsoil and mixing it with the top soil. They plough from 10 to 14 inches deep; but the usual depth of ploughing is for wheat 5 or 6 inches; and on the high lands we cultivate from 6 to 8 or 9 inches deep. Two horses easily plough 5 roods a-day on the fen; on the high lands early in the season 2 horses will plough from 3 to 4 roods per day; but in winter and spring, when the land gets wet and sticks a good deal, we usually plough with 3 horses at length, to avoid treading, and they plough just 3 roods daily."

(26.) "Three-fourths of the farm is a light chalky soil, the remainder a rather stiff red gravel resting upon the chalk. The wheat stubbles are usually ploughed about 7 inches deep in the autumn by 3 or 4 horses. The average depth for wheat, barley, &c., is about 5 inches. An average day's work is a statute acre, done by a pair of horses abreast."

(27.) "The soil is a marl on a chalk subsoil; the depth of cultivation is from 6 to 7 inches. An acre and a quarter to an acre and a half is a day's work—4 horses to a team."

(28.) "One hundred and twenty acres a clay mould; 120 acres peaty, on a sandy subsoil, but damp—reclaimed from swamp; 55 acres sharp gravel. The ordinary depth of furrow is 8 inches; if subsoiled, 15 inches."

(29.) "Soil loamy, with clay subsoil. Ploughing 6 to 7 inches deep. Three roods a-day in winter; 1 acre in summer by 2 horses."

(30.) "Soil varying from mere sand to gravelly sand, and in places many boulders. The depth of cultivation varies according to crop from 5 to 7 inches, except one deep ploughing in preparation for turnips from 10 to 11 inches. A day's work at plough varies from 1 acre of hard work to 1½ or even more of light fallow ploughing; ploughing clover lea for wheat 1¼ acre per day; and perhaps the average ploughing of all sorts is 1¼ acre daily, done in 8 or 9 hours —2 horses to a team."

(32.) "Soil medium. Lea furrow 6 inches deep. Part ploughed in autumn 8 to 11 inches deep, rest say 7 or 8."

(6.) "Soil, a sand over 140 acres; a clayey loam over 80 acres; a light brashy soil over 20 acres. Ploughed from 5 to 10 inches deep, according to the crop."

Even the extremely various character of the land, and the great differences in the treatment of it, as above described, fail, however, to account for the whole of those differences in the price of horse-labour per acre which Table III. describes. There is a large remainder after the amplest deduction on this account, which must be put down either to varying stable management on the one hand, or to varying laboriousness of cultivation on the other. The number of acres cultivated per horse—*i. e.* excluding from the whole acreage of the farm not only the permanent pasture-land, but the extent in clovers and grasses—varies exceedingly; no less, indeed, than from 18 and 15 in the case of Nos. 15 and 27, to 31 and 30 in the case of Nos. 14 and 6. From the accounts which have been given me there does not appear to have been that greater laboriousness of cultivation, either involuntary, arising from the character of the soil, or

voluntary, arising from deeper and more frequent cultivation, which would explain such differences as appear in these tables. The further information which is to be extracted from a study of them must be left to be gathered by the reader. It is worth while pointing out to him how the number of horses kept on a given extent of land overrules in its ultimate effect the most economical style of stable management. Mr. Sandford's horses cost him only 16*l.* 6*s.* each per annum for their food, *i. e.* about half as much as those of Mr. Melvin; and yet the expenditure of the latter per acre for horse-labour, high as it is when compared with the other cases on the list, is not so high as that of Mr. Sandford.

This paper is intended to be merely descriptive of actual practice; and, excepting by pointing out existing differences, I have not pretended to offer any remarks on stable management, by way of either censure or recommendation. The following report, however, by Mr. Baker of Writtle, on this subject, I give in full, as it describes what seems to me very excellent management, and, excepting perhaps the entire absence of succulent food—carrots or Swedish turnips—from the winter feeding, worthy of general adoption. I have not interfered with the scale of valuation adopted in its calculations, although it differs from my own; and I have given the whole statement, notwithstanding that certain passages do not strictly bear upon the subject of this paper:—

"My present treatment of horses from Michaelmas (29th Sept.) to April is as follows:—

Clover hay	10 lbs.	cut into chaff.
Straw	20 lbs.	
Good oats	10 lbs.	
	40 lbs. per diem.	

During the seed-times (about 5 weeks each) 4 or 5 lbs. of good old split beans additional are given per diem, and from the end of November till the middle of February the oats are in part taken off, according to circumstances—say to 6 lbs. per diem, the full quantity of 10 lbs. being given always whilst at plough-work. My horses invariably plough an acre per day—a pair of horses only, with reins to each plough and without a driver. For heavy work of extra depth three horses are used, and for roots the depth of furrow is increased by using two ploughs with two horses each, one following the other, the hinder plough not having a breast upon it. By this double operation the land is worked 12 inches deep, at a less expense than could be accomplished by one ploughing. A single ploughing varies from 6 to 9 inches in depth; we plough deeply for roots, but not for wheat or beans.

"During the spring months, say from the middle of April, my horses have early rye, mown green, and cut up with the hay and straw, increasing the former and diminishing the two latter weekly, until by the middle of May rye alone is used cut as before; and the horses will continue to eat it when so managed until the middle of June, when the rye has come fully into ear, and at that period they get in better condition than at any other portion of the year. From the time that the rye ceases, vetches with rye are substituted

for about two weeks, and then vetches, or red clover mown, or lucerne, are substituted, but not always cut up, as before, into chaff. The horses are kept in the yard so long as food can be procured, which is sometimes the case until the second math of red clover is fit for mowing, which is combined with hay and straw, and cut up daily for the teams *ad libitum*. If, however, the math is abundant, it is given alone, *i.e.* with only the addition of late spring tares, if the season is suitable; but this depends entirely upon the season, as in case of drought the late tares do not succeed in the eastern counties.

"My horses I calculate eat 1 peck of 10 lbs. of good sound oats, or say 2 bushels per week for eight months in the year; and when eating green food in the summer months, say 1 bushel each per week—rather less than more; but upon heavy land farms another bushel of oats, or beans and oats, is given for six weeks in the autumn and spring seed-times per week. A horse will require dry food at least seven months in the year, and, eating about 21 lbs. per diem, will during that period consume 35 cwt. of hay per annum; he will eat in addition about 1 cwt. of green food per diem during the remainder of the year, say 150 days, or from 7 to 7½ tons for that time. The best of the straw, and pea and bean straw, from the crops, may be reckoned to supply food for two months of the year.

"The cost of horse-keep in Essex upon the above principle of management will for each day be about the same as that of a farm-labourer, but for all calculations a further sum must be added to meet the wear and tear of the horse and for shoeing, to which the farmer is not liable as regards manual labour. The sum of 3*s.* per horse per day during that portion of the year comprised from Lady-day to Michaelmas is assumed by valuers as the fair sum to be paid for each horse for each working day when at plough, and 2*s.* 6*d.* when at other work, per diem. An experiment was once made by myself, and the conclusion arrived at as to the food consumed per annum by a horse was as follows:—

	£.	*s.*	*d.*
2 tons of hay at feeding value	6	0	0
7 tons of green food at 20*s.*	7	0	0
9 qrs. oats at 24*s.*	10	16	0
1 qr. of beans at	1	16	0
Add straw and chaff	1	10	0
For keep of one year	27	2	0
Blacksmith .. .. 10*s.*; Harness .. .. .. 5*s.*; Wear and tear .. .. 60*s.*	3	15	0
	30	17	0
Working days 300, say at 2*s.* per day	30	0	0

So that, taking contingencies into calculation, 2*s.* 6*d.* per horse per day would be a fair estimate for the labour of a horse whilst at plough and cart work.

"In Essex 4 horses are considered sufficient for tilling 100 acres of medium quality of land, and from 5 to 5½ per 100 acres of heavy land.

"The value of the cart-horses usually employed varies from 30*l.* to 45*l.* each, upon the tenacious clay soils about 5*l.* to 7*l.* more. It is the horse-labour upon the heavy soils that trenches so far upon the production as to become the most serious item of expenditure that the farmer has to contend against. The valuations for fallows vary from 2*l.* 14*s.* to 3*l.* 12*s.* per statute acre for ploughings and tillages only, and with the rent allowed upon fallowed land rarely amount to less than 5*l.* per acre.

"My horses are fed in open yards, with sheds, each parted off for a team of 4. These, upon returning from labour, are unharnessed and fed in the stable until about 6 o'clock, when they are put into the yard with a sufficiency of cut chaff for the night. At from 4 to 5 o'clock in the morning they are brought into the stable, and fed with the corn and chaff until the time of going out to work—in summer ½ past 5 o'clock, in autumn ½ past 6 o'clock, and in winter rather later. They work until 10 o'clock, and invariably come home and are fed and watered, one hour being allowed. They then return and work till 3 o'clock, an acre of ploughing being performed. This mode of management appears congenial to the health of the horses, as we rarely have any sickness among the teams, and I have not lost more than two horses during the last six years from upwards of twenty constantly worked.

"I have turned my attention to the use of machinery for ploughing and tilling the soil, and fear that its introduction will not and cannot supersede horses, as regards expense, and certainly not as regards convenience. It will doubtless become a powerful auxiliary to farming, and at the season when much work has to be performed in a short time it may be brought into active and profitable employment. I have tested it in drawing and threshing, and can effect both operations at as little cost—taking all other matters into consideration—by horse as by steam-power, when carried out by locomotive engines.

"R. Baker.

"*Writtle, near Chelmsford.*"

I propose now, in those instances where the reports have been drawn up in sufficient detail, to attempt the application of the only proper test of merit in this department of farm management, namely, the comparison, not of acres cultivated, but of labour on those acres done, with the cost of doing it. This comparison is not possible, nor indeed is it desirable, in more than a few instances. The result arrived at will indicate what Professor Wilson asked for—the cost of horse-labour under different styles of management, per cwt. of draught at a given rate of motion.

The common definition of horse-power is the ability to lift 33,000 lbs. 1 ft. high per minute. This is perfectly consistent with the results of such experiments on the draught of ploughs as have been published. Thus, when two horses pull a plough along at the rate of 2½ miles in an hour, and the tension on the draught chain is equal to a lift of 300 lbs.—no uncommon case—they do in effect lift that 300 lbs. 220 ft. per minute, that being the sixtieth part of 2½ miles; and this is equivalent to a lift of 66,000 lbs., or just the 33,000 lbs. apiece, 1 ft. high per minute, which is the ordinary mechanical expression of one-horse power. This power, however, is not continuously exerted. The plough, though drawn at the rate of 2½ miles per hour, is not drawn 25 miles in a day of 10 hours; it is not often drawn much more than 10 miles in that time, in consequence of loss of time on headlands, &c. In fact, the plough is drawn barely

10 miles in turning over one acre in furrow-slices 10 inches wide. In this lies one great difference between animal and steam-power, namely, the persistence of the latter, if only methods of continuously employing it can be devised. The really effective work of a horse per diem thus does not much exceed one-half of that calculated from its work per minute; and its annual performance must be often still further reduced below the theoretical standard by the occurrence of days when it remains idle in the stable.

In some of the instances described above, I have received such a detailed account of the work done upon the farms, as enables me to estimate with some confidence the *total* annual draught accomplished during its cultivation. The following, for instance, were the details of cultivation on my father's farm, at Whitfield. On 120 acres of it wheat was annually grown: the cultivation of this consisted of 1 ploughing, 3 harrowings, 1 drilling, 1 rolling, the carting of the produce (2 tons per acre) ¾ of a mile to the homestead, and the carting of some 100 tons of grain perhaps 6 miles to market. On 60 acres of root-crops there were 1 deep ploughing, and probably 2 shallower ploughings, 3 "cultivatings," probably 10 harrowings, 2 rollings, twice ribbing when covering the manure, 1 drilling, 3 horse-hoeings, the carting of 15 tons of dung per acre to the land, and the carting of 25 tons of produce from the land ¾ of a mile. On 30 acres of clover there was 1 rolling, and the carting of 15 tons of green food per acre from 10 acres, and the carting of 20 tons of hay off 10 acres ¾ of a mile. On 30 acres of beans there were 2 ploughings, 2 "cultivatings," 4 harrowings, 1 drilling, 2 horse-hoeings, 10 tons of dung per acre carried ¾ of a mile, 2½ tons per acre of produce carried home ¾ of a mile. I have the number of miles walked per acre in performing every operation, and I can from experience and experiment pretty nearly estimate the draught in every case. In the case of produce and manure carried I add the weight of the cart going and returning, which just doubles the quantity of cartage; and 10 per cent. is charged upon the weight for draught, this being what seems to me fair, on comparing Mr. Brunel's experiments on this subject with the ordinary character of cartage on the farm.* It is plain that in all these particulars I have the complete history of the labour of cultivating and carrying the crops of the farm, which accordingly is given in the following Table:—

* He found that the draught on a dry good road was 3 per cent. of the weight; on a wet good road it was 4 per cent; on hard, compact loam it was 5½ per cent.; on ordinary byeroads it was 10½ per cent.; on a newly-gravelled turnpike-road it was 14½ per cent.; and on a loose sandy road it was more than one-fifth, or 20 per cent. of the weight.

HORSE-LABOUR ON WHITFIELD FARM.

Crops.	Acreage.	Ploughed. Deep.	Ploughed. Ordinary.	Cultivated.	Harrowed.	Rolled.	Ribbed.	Drilled.	Horsehoed.	Dung Carted.		Produce Carted.		Equal to Carting 1 Mile.
		Acrs.	Acres.	Acres.	Acres.	Acrs.	Acrs.	Acrs.	Acres.	Tons.	Miles	Tons.	Miles	Tons.
Roots .	60	60	120	180	600	120	120	60	180	900	¾	1500	¾	1800
Corn .	120	..	120	..	480	120	..	120	..	..	..	240 100	¾ 6	780
Clover.	..	..	..	..	..	30	..	..	..	..	..	150 20	¾ ¾	127½
Beans .	30	..	60	60	120	..	..	30	120	300	¾	75	¾	281¼
Total . .		60	300	240	1200	270	120	210	300	..	..	..	..	2989
Multiply by the miles walked per acre . .		8	10	3	1⅓	2	3	2	3	Add for weight of carts				2989
Miles walked.		480	3,000	720	1600	540	360	420	900					5978
Multiply by the draught in cwts. .		5	3½	4	3	2	3	3	1½	10 per cent. on which is				
Cwts. of draught .		2200	10,500	2880	4800	1080	1080	1260	1350	11,956 cwts. drawn 1 mile.				

These figures represent the cwts. drawn (= lifted) one mile in the several operations; and, adding them together, we have the annual labour of the farm, which amounted, in the case before us, to 37,106 cwt. drawn (= lifted) one mile per annum. For the words "per annum" we may substitute 300 days of 9 hours each, and the work done will be found on calculation to have been equal to the lift of 135,450 lbs. one foot high per minute during all that time; which, as 7 horses were employed, was 16,492 lbs. apiece, or about one-half the theoretical quantity—a very high average, however, as will appear from what I have already said. In order to ascertain the cost of horse-power in this case, we must assume a rate of movement natural to the draught animal—say 2½ miles per hour. The work done was 37,106 cwts. drawn (= lifted) one mile in 2700 hours: this is equivalent to 14,842 cwts. drawn 2½ miles in 2700 hours, or 5½ cwts. drawn that distance every hour. But the cost of horse labour on this farm was 381*l.* 10*s.* per annum, or 2*s.* 10*d.* per hour—that then was the cost of drawing (= lifting) 5½ cwts. 2½ miles in that time. Horse-power on Whitfield farm thus cost as nearly as possible 6*d.* per cwt. drawn 2½ miles at that rate of movement. If the ploughing of an acre was equal to lifting 3 cwt. 10 miles, then by horse-power it was done for 6*s.*; if it was equal to lifting 5 cwt 8 miles (I name fewer miles, because the greater draught implies greater depth of ploughing, and deeper ploughing involves a wider furrow-slice), then it cost 8*s.* per acre. And these are the figures with which an engineer would have to compare the performance of his engine.

Take now the case of Mr. Melvin's farm. In order to understand some of the figures in the cartage columns of the following Table, it is necessary to extract the following particulars from

Mr. Melvin's Report. "There are 1600 tons of manure carted 2 miles. Three-fourths of the grain is carted 10 miles, one-fourth 3½ miles; 48 tons of linseed or other cake are carted 12 miles; 120 tons of coal are carted 11 miles."

HORSE-LABOUR ON MR. MELVIN'S FARM.

Crops.	Acreage.	Ploughed. Deep.	Ploughed. Ordinary.	Cultivated.	Harrowed.	Rolled.	Ribbed.	Drilled.	Horsehoed.	Dung Carted.		Produce Carted.		Equal to Carting 1 Mile.
		Acrs.	Acres.	Acres.	Acres.	Acrs.	Acrs.	Acrs.	Acres.	Tons.	Miles	Tons.	Miles	Tons.
Potatoes	30	30	60	..	180	30	90	..	60	660	1¼	180	4	1545
Turnips	95	95	95	95	950	190	190	95	285	1615	1¼	1800	½	2920
Beans .	50	..	50	50	400	50	100	..	50	850	1¼	125	1¼	1620
												36	10	
												12	3½	
Corn .	300	..	300	..	1,800	300	..	..	..	30	12	225	10	2870
												75	3½	
Clover, &c. .	50	..	..	..	..	50	..	..	..	..	..	150	1¼	987
												80	10	
Pasture	150	..	..	..	..	..	..	..	Dung	1600	2	..	..	3200
									Coals	120	11	..	..	1320
									Coke	48	12	..	..	576
Total.	675	125	505	175	3,300	620	380	95	395	..	..	..	..	15,038
Multiply by the miles walked per acre . .		8	10	3	1¼	2	3	3	3	Add for weight of carts				15,038
														30,076
Miles walked .		1000	5,050	525	4,162	1240	1140	285	1185					
Multiply by the draught in cwts. .		5	4*	4	3	2	3	1	1½	10 per cent. on which is				
Cwts. of draught .		5000	20,200	2100	12,486	2480	3420	285	1777	60,152 cwts. drawn 1 mile.†				

* Mr. Melvin's ordinary depth of ploughing is somewhat greater than it was on Whitfield Farm, and I estimate the draught a little higher. Two ploughings are put down against potatoes—the labour of ploughing them up, &c., being assumed as equal to one.

† I would have reduced the percentage here, as so much of it is on the turnpike-road, but Mr. Melvin's farmstead is on a height, which makes the draught heavier than it would otherwise be.

These figures, let me repeat, represent the cwts. drawn (= lifted) one mile in the course of the several operations annually; and adding them together, we have the annual labour of the farm equal to 107,900 cwts. drawn (= lifted) one mile per annum; or substituting for the year 300 days of 9 hours each, the work done will be, according to calculation, equal to the lift of 393,875 lbs. one foot high per minute during all that time, which, as 20 horses are employed, is 19,693 lbs. apiece, considerably more than on Whitfield farm, and a very high average performance indeed. The work done annually corresponds to 43,160 cwts. lifted 2½ miles per annum, or 15·98 cwts. per hour during the year. Now Mr. Melvin's horse labour costs him 1131*l.* 10*s.* a-year, or 8*s.* 4*d.* per hour during the year. Horse-power in his case then costs rather more than 6*d.* per cwt. drawn (= lifted) 2½ miles, at the rate of movement specified. If his horses walk 8 miles in ploughing an acre with a 5 cwt. draught (which indicates very deep and heavy work), the work is done for 8*s.* per acre.

It is plain that the instances I have given must be taken rather as illustrations of the mode of calculation to be adopted than as conveying what is absolutely true of the two cases specified. That there are many unavoidable liabilities to error in these calculations I readily admit; but that they give an approximation to the truth will, I suppose, be generally admitted. If you can enumerate all the operations on your farm, together with the draught incurred in accomplishing them, then you can easily convert the whole into weight lifted through a certain space in a certain time. If you can record the cost of horse food, of extras, of ploughmen, and of keeping up live and dead stock, then against the work done you can place the exact cost of doing it; and the comparison leads, as in the two cases worked out above, to the cost of horse-power "per cwt. of draught, at a given rate of movement."

It would be tedious to examine in detail the other instances given in Table III.; but I may add here, as the result of such an examination, that I believe the following Table describes pretty nearly the experience of those whose names are given:—

Number on Table III.	Name.	Performance per Horse, *i.e.* lbs. lifted 1 foot per Minute.	Annual Labour.		Cost of Horse-labour.				Cost of Horse-power per cwt. drawn $2\frac{1}{2}$ miles.
			Cwts. drawn 1 mile per Annum.	Cwts. drawn $2\frac{1}{4}$ miles per Hour.	Per Annum.		Per Hour.		
		lbs.	cwts.	cwts.	£.	*s.*	*s.*	*d.*	*d.*
10	Aitken ..	18,250	100,000	14·8	873	0	6	$5\frac{3}{4}$	$5\frac{1}{4}$
13	Coleman ..	14,354	44,000	6·5	471	5	3	6	$6\frac{1}{3}$
19	Laidlaw * ..	16,052	30,800	4·5	346	12	2	$6\frac{3}{4}$	$6\frac{3}{4}$
30	Wilson ..	16,957	93,800	13·88	981	16	7	$3\frac{1}{2}$	$6\frac{1}{4}$
32	Melvin ..	19,693	107,900	15·98	1131	10	8	$4\frac{1}{2}$	6
6	Morton ..	16,492	37,106	5·5	381	10	2	10	6

* Mr. Laidlaw tells me he sometimes draws 700 or 800 loads of Severn mud $1\frac{1}{2}$ miles in the course of the summer; and this is here added to the work of the farm, and does of course increase the performance of his horses.

These figures, let me repeat, are necessarily mere approximations to the truth. They are given, of course, without regard to any personal bearings they may have, simply as the results to which calculation, on the data furnished to me, has led. No doubt exception may be taken to many of them; they may, however, be safely taken, both as illustrating the way in which the cost of horse-power must be calculated, and also as showing that very considerable differences do exist in the expense of horse labour as it is managed on different farms.

I conclude with a reference to the competition of steam-power with that of draught animals in the work of cultivation. Whether under the most economical and productive management

of the horses of the farm the cost of the ploughing done by them at Chester would not have been less than that at which, according to the "Report," it was accomplished by Mr. Fowler's steam-plough may be questioned. I am inclined to think it would. A nice comparison of the two, to determine a difference of this kind, is, however, quite beside the agricultural bearings of the subject. Mr. Baker, of Writtle, expresses his belief above, that even thrashing can be done as cheaply by horse-power as by locomotive steam-engines; but that does not hinder him from employing the latter in order to the speedy accomplishment of the work, and the setting free his horses for other employment. The superiority of steam-power for such purposes is so great that no one now is curious to inquire into the question of exact comparative expense. And so it will be with steam-power applied to cultivation. It will be applicable at the overcrowded seasons of horse labour. A much smaller number of horses kept throughout the year will suffice for the annual work of the farm when a portion of the labour of the spring and autumn months can be thus taken from them. And a direct advantage of this kind, added to the indirect advantages of the deeper and more thorough tillage which steam-power can effect, will ensure its ultimate adoption, "altogether irrespectively of narrow differences of cost per acre."

Streatley, Reading, Dec. 1858.

XX.—*On the Structure of Roots.* By Professor Henfrey, F.R.S., &c.

When we undertake a general examination of any subject relating to plants, whether it be a scientific inquiry into the laws of their growth, or a practical discussion of the economic value of their products, we are naturally led to make a certain arrangement and distribution of our questions. Such arrangements are forced upon us by the diversity of character of the parts of the plants themselves, and by the diversity of the products and of the means by which additional amounts of their products are obtained. Even if we confine ourselves to the comparatively limited, although most important, group of plants with which the agricultural communities of climates like our own are concerned, we shall derive great advantage from a systematic method of research; and if we take care to keep this in its proper position, as an instrument, and not as the object of our work, it will be found to facilitate the explanations of our results when we attempt to draw them up in

a manner suitable for the instruction of those who do not possess strict scientific knowledge.

In dealing with plants we have great advantages over those who devote themselves to the higher branch of the organic creation, in the simplicity and obviousness of the parts of the structure, and the functions these fulfil. When the botanist distributes the various portions of a flowering-plant under the heads of *organs of vegetation* and *organs of reproduction*—and subdivides the former into *root*, *stem*, and *leaf*, and the latter into *envelopes*, *essential organs*, *fruits*, and *seeds*—his operation is merely the carrying out more strictly and accurately of an arrangement of objects familiar to every one, into classes which are more or less clearly and fully comprehended by all those who have thought or talked about plants. The three great classes of agricultural produce, *seeds*, *roots*, and *fodder*, already correspond to the most important of the above heads, and the well-known differences in the modes of treatment requisite to cause predominance of any one or other of these classes of products in any given plant, indicate the importance of studying the parts or organs separately as well as collectively. Yet the well-being of a plant, in a state of nature, depends upon the balance maintained between the tendencies of its different parts; these tendencies being in some particulars quite opposed to each other. External conditions may greatly disturb the balance, so that one tendency manifests itself in excess, in which case it is ordinarily at the expense of another tendency. This is strongly shown in the opposition between the tendencies residing respectively in the two classes of organs which are denominated *vegetative* and *reproductive.* When a plant produces the first class of organs in unusual luxuriance, the production of the second class is impeded; and *vice versa*, when plants are starved in their vegetation the whole energy appears to throw itself into the reproductive system, to save the race, as it were, even if the individual must perish.* Illustrations of these general reflections will suggest themselves to every thinking cultivator, and it is needless to dwell at length upon them. They are thrown out here by way of explanation of the present inquiry, in which we shall endeavour to elucidate the most important points of the natural history of one kind of organ, the Root, of the plants chiefly cultivated by our farmers, or forming troublesome weeds, but in which we shall be compelled also to undertake the examination of roots generally, and to treat the root not as an independent product, but as an essential part of the structure of the higher classes of plants.

* For instance, we have seen the common garden poppy growing in a neglected mignonette-box, with fully-developed flowers, where the entire little plants were little more than an inch high. Such examples are common on barren soils.

It is a general character of all plants which produce flowers, that they possess all the kinds of organs of vegetation, *i. e. stem*, *root*, and *leaf*, in a rudimentary form, at the time when they become independent of their parent. They are reproduced by *seeds*, properly so called, the principal distinctive character of which is, that they contain an *embryo*, or infant plant, composed of the vegetative organs above mentioned, in a more or less developed state. If we remove the skin of a turnip-seed, we find within an embryo, on which we can distinguish two expanded laminæ, representing leaves, called the *cotyledons* or seed-lobes, attached upon a stalk curved over upon the seed-lobes, and attenuated at the other end; the attenuated end is the *radicle* or rudimentary root, the intermediate portion is the rudimentary stem, and if we separate the two cotyledons, we find it terminating at its upper end in a minute leaf-bud, the point whence the future upright stem will rise. In this case, as in all the Cruciferæ (or cabbage family), the embryo forms the whole seed excepting the coat or skin. The same is the case in the seeds of beans, pease, and other leguminous plants. In many cases a similar embryo of smaller size lies imbedded in a mass of substance of horny, fleshy, or floury consistence: an external provision of food, called *endosperm*, provided for the same purpose as the substances contained in the large cotyledons of the turnip, bean, &c., namely, to feed the embryo plant in germination, before its root has acquired the power of drawing nourishment from the soil. This is the structure of the seed of flax, carrots, parsnips, beet, &c.

The arrangement, such as we have just described, does not prevail, however, in all flowering plants, nor even in all those with which we have concern in the present paper. In fact, the two primary divisions of flowering plants forming seeds in closed seed-vessels, are characterized most strikingly by the diversity in the structure of their seeds. All those presenting the characters above indicated are combined under the name of *Dicotyledons*, or plants with *two* seed-lobes, and separated from the *Monocotyledons*, or plants with *one* seed-lobe to the embryo. Of the latter class we have examples in the seeds of the corn-plants, and other grasses, in the onion tribe, &c. In them the rudimentary stem is not surmounted by a pair of cotyledons with the bud between them, but a single cotyledon exists, folded round the upper part of the stem, and enclosing the bud much in the same way as the leaves of young grass-plants are rolled round and enclose the bud which afterwards throws out the ear.

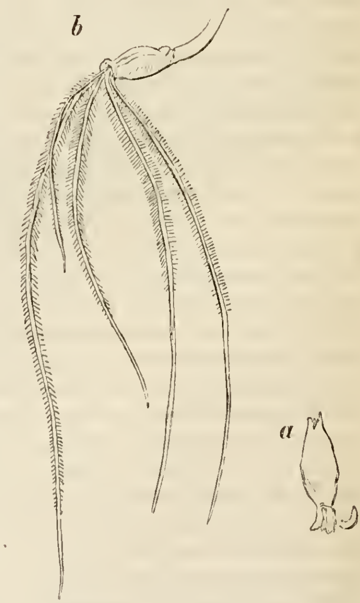
This diversity of plan in the seed does not at first sight seem to be of much practical importance. But it is connected with

many other diversities, and serves as a key to them, or indication of their presence; and some of these diversities are presented in the anatomy and development of the roots in which we are more immediately interested. Not only do the Dicotyledonous or Monocotyledonous plants differ in the structure of their stems, the characters of their leaves and their flowers, but the first manifestation of independent life, the germination of the seed and development of the embryo, exhibits a peculiarity in each of these two great classes. In the Dicotyledons the *radicle* or rudimentary root grows directly downward, constituting an inferior prolongation of the stem (fig. 1); in the Monocotyledons this rudimentary root is never developed, but lateral rootlets are thrown out at the sides, so that from the first these plants have a tuft of fibrous (fig. 2) or thread-like roots, contrasting with the

Fig. 1.

Seedling plant of Field Speedwell (*Veronica.*)

Fig. 2.

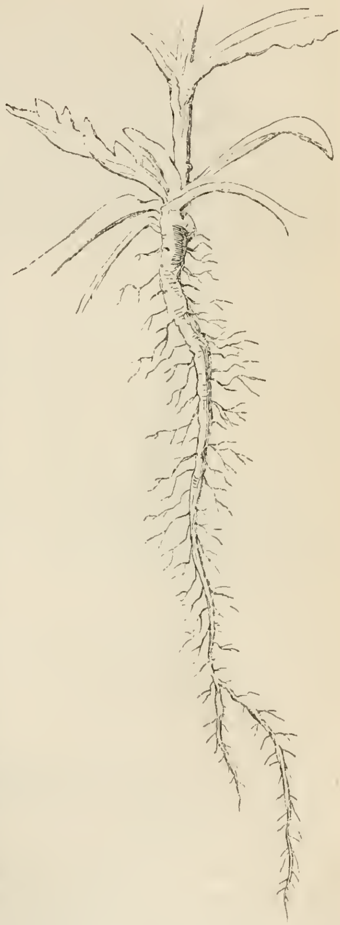


Germinating barley: *a*, seed sprouting; *b*, more advanced, the rootlets clothed with fibrils.

more or less branched single tap-root of the Dicotyledons (fig. 3). These substitutes for the tap-root, called by botanists *adventitious*

roots, are the only roots of Monocotyledons; but this kind of root is by no means confined to that class; adventitious roots occur in Dicotyledons also in every case where the plant forms roots from the stem, independently of the tap-root of the seed, as in all cuttings, and natural propagula of all kinds, such as tubers, strawberry runners, &c.

Fig. 3.



Root of Shepherd's Purse.

A root therefore may be a true *descending axis*, as it is sometimes called, that is the prolongation of the lower end of the stem; but roots are constantly formed from the side of the stem, either near its base or at or in the neighbourhood of the places where leaves are attached; they break out from beneath the rind of the stem, and thus are surrounded at the point of exit by a little ragged collar; also, when they decay and fall off, as is commonly the case with those formed underground, they leave a scar-like hole at the place where they emerged. Adventitious roots are also developed from the sides of tap-roots.

The difference between true tap-roots and adventitious roots is not of great importance, although they frequently give the character to the general form and arrangement of the root structures; the tap-root, forming the characteristic branched *descending axis* of the Dicotyledons, such as turnips, peas and beans, flax, &c., is a direct production of the lower end of the stem. But in perennial herbaceous plants which are propagated by stools, or offsets, one of the adventitious roots of the offset sometimes assumes all the ordinary characters of a tap-root, as in the monkshood.

The adventitious roots which supply the place of the tap-root in Monocotyledons like grasses, corn-plants, onions, asparagus, &c., by their number and equal size give a fibrous character.

The peculiarities of this kind of root are well seen in onions raised from seed; the bulb is really the base of the stem enclosed in leaf-scales, and this bears on its under surface a circle of thread-like adventitious roots, which do not arise from the centre of the base of the stem, but at its sides or edges. But exactly similar adventitious roots are found in abundance of Dicotyledons which are propagated by offsets, tubers, runners, &c., of which the strawberry, the creeping crow-foot, &c., are common examples. Roots of a fibrous character are, however, met with as productions of a true descending axis in many Dicotyledonous plants, more particularly annuals. This condition arises from the main axis of the root throwing out numerous long branches which repeat the ramification (fig. 4). These branches arise from the sides of the tap-root in very regular order in many plants, standing in two, four, or five equidistant rows, which are naturally perpendicular, but by a twisting of the tap-root are sometimes rendered oblique. But their arrangement does not always exhibit the spiral character which we see in the arrangement of leaves, and which is generally very evident in the arrangement of the adventitious roots at the base of Monocotyledonous stems.

Fig. 4.

Root of a young plant of Groundsel, with adventitious roots arising from the lower part of the stem, above the tap-root.

The finer branches of the roots of Dicotyledons and Monocotyledons, but more particularly of the former, are clothed more or less abundantly with fine hair-like fibrils, of which more will be said hereafter. These must not be confounded with the real rootlets. Roots of both the kinds above distinguished exhibit a great variety of external forms and modifications of internal structure. These are connected in part, especially the former, with the "habit," or mode of life, of the particular plants, and it will be desirable to direct attention to some of the more striking and instructive instances, before entering upon the special examination of the roots especially interesting to the farmer.

While we observe a remarkable simplicity in the organization of plants, as regards the number of physiologically different kinds of parts of which they are composed, even a limited acquaintance with vegetable life teaches us, that the simplicity of general plan

is combined with an almost infinite amount of variation in the details in which it is carried out. This circumstance gives rise to two of the principal difficulties standing in the way of those whose business it is to convey botanical knowledge to the uninitiated. On one hand the great variety of forms and conditions assumed by the parts of plants demand especial names, so that they may be referred to in language sufficiently brief; on the other hand the scientific definition of the organs of plants, that is to say, the exact description of those characteristics which completely and at the same time exclusively distinguish each kind of organ, is rendered a task requiring the utmost care; and indeed, if we look for absolute accuracy and the exclusion of all that does not hold good universally, this becomes an impossibility.

The attempt to define the Root is a fair example of these difficulties. And that these questions are not mere "curiosities" of science, but involve most important practical conclusions, is nowhere better seen than in this kind of organ. A root is generally known as that part of a plant which grows downwards into the ground, and in the soil takes up the principal part of the nourishment required by the rest of the structures. Speaking a little more strictly we may say it is the descending portion of the same central body (*axis*) which rises upwards in the form of the stem. What we have spoken of above as a true root corresponds exactly to this; when only adventitious roots exist, these form collectively a descending bundle corresponding to the single axis of the tap-root.

When we turn our attention to practical facts, we soon arrive at some questions which disturb our reliance in the above definitions. The growing downwards of roots is a matter only of a few inches, or a few feet, as the case may be, and they usually then turn right and left under pain of destruction from the want of those influences which are present in the upper layers of the ground. Then as to function. The ivy on the garden wall exhibits to us undoubted roots, in abundance, exerting no nourishing office, but forming simple hold-fasts enabling the stem to climb.

The first of the exceptions just taken is by far the most important in a practical point of view. Those prolongations of the originally descending root which run out horizontally in the soil are very liable to be confounded with the stems of a vast number of perennial herbaceous plants which grow in a similar situation, beneath the surface of the soil, and acquire very much of the external appearance of roots. So much is this the case, that the forms of stem now referred to are commonly known in gardens under the title of roots, their true nature as stems being

overlooked. The daisy, the primrose, the flag, in fact nearly all the herbaceous perennials of our gardens, with the perennial grasses, sedges, rushes, &c., are examples of plants in which the main stem does not ascend above ground, but creeps along in the manner of a root, beneath the surface, throwing out adventitious roots below, and leafy flowering stems above, which sprout, flourish, and disappear, in successive generations, corresponding to the annual foliation of a tree, while the main trunk, called by botanists a *rootstock*, maintains itself during a more or less extended period of existence. These rootstocks are very like roots when viewed superficially. They are vulgarly called roots, and it is a familiar phrase in reference to propagating these plants to say we *part the roots*. Now, no one ever raised young oaks from fragments of the root; as a general rule, pieces cut from the roots of plants with upright stems die away and produce nothing. This point is also illustrated by organs which have undergone a particular modification which affects both stems and roots. We can cut a pôtatoe into a number of pieces and raise a plant from each, but it is useless to cut up a carrot or a turnip with a similar expectation. The latter are roots, the potatoe, although commonly called so, is really a piece of a stem—a transformed branch; and the characters by which we prove this, are in the same way applicable to all kinds of *rootstocks* and similar subterraneously growing stems. We can readily detect in potatoes the eyes, which in their first pushing in spring become little green leaf-buds; if we examine the tubers during the period of their formation we find a little membraneous scale covering the spot where the eye is afterwards formed: this scale is a rudimentary leaf. On the turnip or carrot the bud or buds are all assembled at the upper end, the region where the stem and root, ascending and descending growths, set out in opposite directions.

It is a rule in physiological botany that buds, in general, natural cases, make their appearance only at the points of stems and branches, or in the corner (axil) which the upper side of a leaf or leaf-stalk makes with the stem from which it arises. If there are no leaves there are no side-buds, if no side-buds no branches. This leads us then to a means of scientifically distinguishing roots from rootstocks and the like (which is to say, practically, organs which cannot be multiplied by cuttings from those which can), namely, we can distinguish the stem-structure disguised under the form of a root by the presence of scars of leaves, or membraneous or fleshy scales representing leaves; and while in a great many cases we are already helped by the presence of buds in the axils of those scars or scales, favourable conditions applied to the rootstock will bring them out if undeveloped. The absence

of germs of leaves, and the consequent inability to produce buds, is therefore one of the principal negative characters by which roots are scientifically distinguished.

This character will carry us on pretty smoothly for a time, but, like all our generalities, it will break down sometimes; and, indeed, it proves unreliable in some cases very near at hand, and some of no little practical importance. For instance, among trees, we find the alder commonly producing buds and new stems from its roots, certain shrubs are artificially propagated by root-cuttings, and several of our field-weeds have the power, under certain circumstances, of producing buds upon their roots, without the previous occurrence of leaves, in the same abnormal or irregular way as they appear upon cuttings of stems or even leaves of plants in our stoves.

Seeing that these abnormal or "accidental" buds arise out of the roots in the same way as they do out of the smooth unscarred parts of stems, we are led to inquire how they originate? What is the common peculiarity of stems and roots which enables both to produce and push out their buds? This is a problem of minute or microscopic anatomy, and when we set ourselves to clear it up, it is not going far aside to apply the same means to ascertain if there exist any more general or any absolutely universal difference between roots, discoverable by the aid of the microscope. Something we shall find in this way. It is almost always possible to distinguish roots from stem-structures by their microscopic characters—among the most important of which are the absence of stomata or breathing-pores in the skin of young roots, the absence of a pith and a true fibrous bark in the older roots of both Monocotyledons and Dicotyledons, and a peculiar mode of arrangement of the woody substance in both, by which their respective roots are distinguishable at once from stems and from each other. As the modes of development of the useful roots under artificial treatment, as well as the theory of the part played by the root in the physiological history of plants, can only be comprehended after a thorough examination of the elementary anatomy of roots, we propose to enter upon this presently; these anatomical characters therefore may be conveniently reserved until we arrive at that portion of our subject.

Having satisfied ourselves that we *can* know a root when we see it, let us next turn for a few minutes to the subject of the various forms and conditions in which roots present themselves to us.

The root exists in a rudimentary condition in the generality of seeds, and it is the part which in germination usually first shows signs of renewed life. In the majority, not in all, however, of the class which are called Dicotyledonous plants, the *radicle* or

nascent root is pushed out through the seed-coats and takes a downward direction of growth, forming thus a real descending axis, or inferior prolongation of the stem. This course of development may be very readily traced in ordinary plants, such as the mustard, turnip, carrot, &c. A simple root of this kind either maintains its original character on a larger or more complete scale, or its appearance becomes eventually changed by secondary growths. In the common shepherd's-purse we have an example of the main root retaining its character as a tap-root, moderately developed and furnished with numerous branches, all much inferior in size. The carrot (fig. 5), parsnip, turnip, radish, and beet, are examples of roots of a similar kind, which, when abundantly nourished, are prone to lose their ordinary woody character and become swollen into large masses of succulent material; these are tuberous tap-roots (fig. 6). When this is the case, the main root is, as before, supported by a quantity of small secondary branches, which, however, from their comparatively small size, may be overlooked by the superficial observer; the lower portion of the root also, for a considerable distance, remains unaffected by the tuberous growth, and displays a quantity of fine fibrous branches which contribute in large part to supply the wants of the plant. The tuberous development in the plants just referred to, does not occur to any considerable extent while the plants are in a state of nature; they then produce only rather thickened spindle-shaped fleshy roots. This fleshy con-

Fig. 5.

Root of a seedling carrot.

Fig. 6.

a, tuberous root of a small garden carrot; *b*, a cross slice, showing that both the rind and the woody axis are swollen; *c* and *d*, perpendicular slices at the place where the tuberous portion passes into the "tail" or woody part of the root.

dition of the roots is chiefly met with in biennial or perennial herbaceous plants, such as do not flower in the season in which they are raised from seed, and do not produce any development of the ascending stem sufficient to provide space for the assimilated nourishment which is always laid up in store by plants previously to their entering into a resting stage. The more highly the yearling plants are fed the more nourishment they will have to store up, and hence the tuberous enlargement of these roots under cultivation.* The internal alterations which produce these changes will be carefully examined when we are examining the structure of roots.

If the plant is a woody perennial, a tree or shrub, the main root merely undergoes enlargement and solidification, accompanied by a more or less considerable development of branches, corresponding to the expansion of the stem or trunk.

In many perennial herbs the tap-root, developed at first, is soon lost sight of in a bunch of fibrous roots, equalling it in size, and of similar structure. For instance, in the groundsel, while the original root is penetrating downwards, and sending out branches as it grows, other and larger branches arise as adventitious roots from the older, upper part of the root, and from the base of the stem, which new roots ultimately rival in size the first, and formerly main, root. Fibrous tufts of roots of this kind are found at the base of many perennial herbs raised from seed, and they exactly resemble the fibrous tufts of roots which are formed by the same plants when they are propagated by cuttings, layers, offsets, &c. Most frequently these roots are of fleshy character and of short duration, being mostly developed late in one season, and, after officiating for the support of the next spring growth, dying away, to be succeeded by others connected with the buds provided for the next succession of developments. The strawberry furnishes a common example of this: when the plants have borne fruit, and are sending out runners, some of the axillary buds remain in close connexion with the old structure, and form short prolongations of the stem (rootstock), on which are developed a number of new adventitious roots, while the old ones on the hinder woody part of the stem die away. In a considerable number of Dycotyledonous herbs of this kind, a portion of these fibrous roots even become tuberous, to lay up a store for future growth, and this is chiefly the case in such plants as die down below the soil annually, and are at the same time devoid of a fleshy or woody rootstock; the stem-structure all disap-

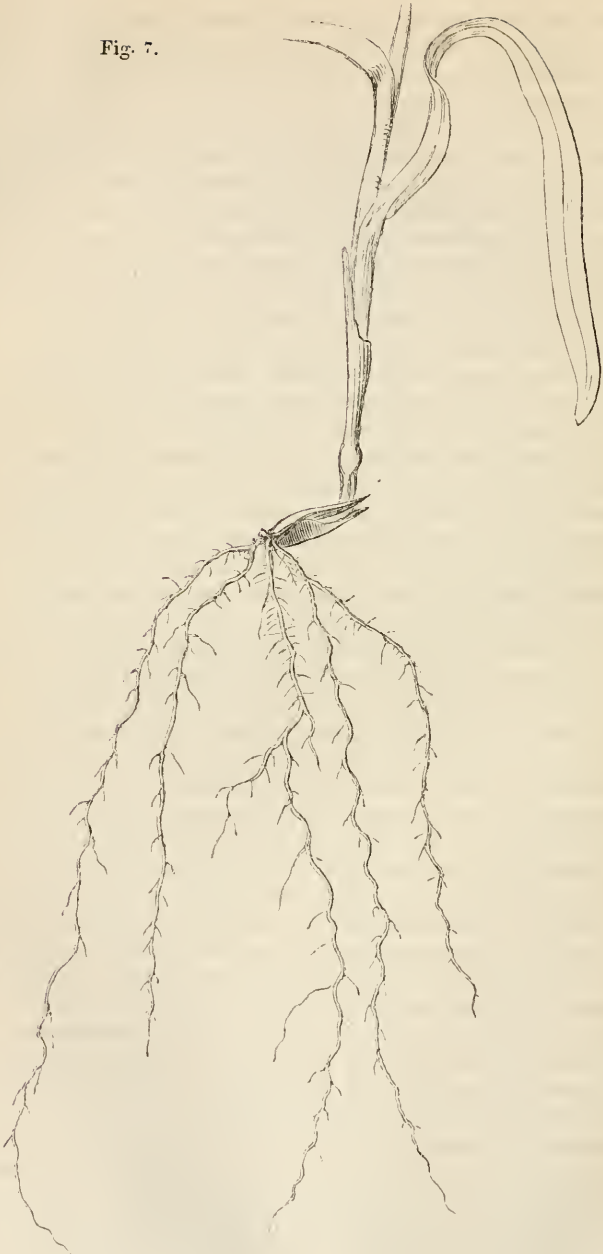
* It must not be forgotten, that particular seasons, or other conditions, may stimulate these biennials to flower in the first season instead of storing up their nutriment in their roots.

pearing down to one bud or several buds collected together, situated at the upper end of a tuft of fleshy, tuberous roots. The dahlia affords a remarkable example of this, as also the peony and other garden plants.

It is a general character of the class of plants called Monocotyledons, that the radicle of their seeds is never developed into a tap-root; hence they always present fibrous roots, which more or less completely resemble externally those of Dicotyledons. If we observe the germination of the seed of barley (fig. 7), we find, instead of an elongating radicle, several equal, thread-like filaments emerging from the seed-coats, having their origin just above the point of the radicle. The same may be observed still more clearly in the onion, since there the cotyledon rises up as a green leaf, and carries the seed-coat with it, leaving the little blunt-ended stem with its tuft of root fibres on the ground. If we follow the growth of the onion, we observe that the stem does not grow up, but forms a wider base for the successively developed leaves, the sheathing bases of which form the bulb; the tuft of roots is produced by the successive increase of a number of new filamentous roots, always outside the old ones: whether we leave the bulb in the ground, or take it up, this central bunch of roots dies after the first season, and when the bulb sprouts again, the new roots spring out outside the scars of the old ones, and thus form a circular group. The same thing is still more evident on the bulbs of the hyacinth. All these roots of Monocotyledons are of the kind which we have called adventitious. This adventitious character is more clearly displayed in the numerous cases where Monocotyledonous plants root at the *nodes* or knots, as in creeping grasses, in the lower joints of Indian corn, and most aquatic grasses, &c. The roots of Monocotyledons are for the most part soft and fleshy, and generally present the form of long threads or cords of equal thickness throughout, which, when they branch, give off the branches at right angles. The roots of Dicotyledons branch, like their stems, by shoots, which are graduated in size from end to end, running off to slender points, and branching less abruptly. The roots of the onion, hyacinth, and other bulbs, are good examples of the simple unbranched form; the roots of the grasses are much branched; but the degree of ramification of the branching roots of Monocotyledons like that of Dicotyledons is apparently dependent very much on external conditions.

Perennial Monocotyledons, dying down annually, which do not provide for their endurance by enlarged stem-structures (buds), such as bulbs and corms, produce tuberous root-structures. In our native orchids one adventitious root each year becomes a tuberous root, to provide for the next season's growth; and before

Fig. 7.



Young plant of barley, showing the branched rootlets.

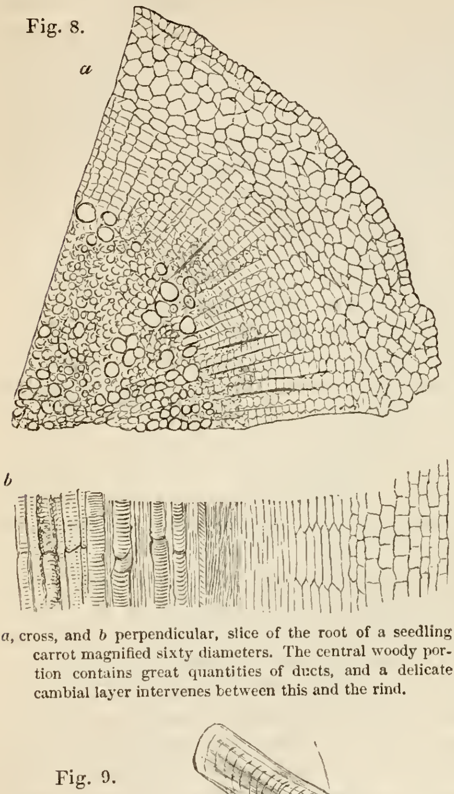
this is exhausted another root assumes the same form, to provide for the succeeding year; so that there are here always two tuberous roots in the group of fibrous roots at the base of the stem. In the day-lily (*Hemerocallis*) a number of roots become thickened at their ends into large knobs in autumn; while in the asparagus all the cylindrical fibrous roots become enlarged and fleshy, resembling pieces of macaroni. It is not worth while to multiply examples; most of these roots have a short period of existence allotted to them, generally corresponding to that of the annually renewed flowering stems, the difference being, that those roots which act as *store-roots* are formed in autumn for the next year's flowers, while in bulbs and corms, the roots, developed with the leaves, are usually devoted to the supply of the nourishment required by the new bulbs formed after flowering. In either case their duration is connected essentially with one generation of stem-buds. In the less familiar cases, where Monocotyledons are arborescent, as in Palms, and in the more accessible case of the *Yucca*, or Adam's Needle of our gardens, the roots are of longer duration, and not only acquire considerable size, but become woody. They still retain, however, their cylindrical, blunt-ended character, and even here die away after a certain time, being replaced by others developed above and outside them at the base of the stem.

So far we have spoken of roots growing in the ordinary condition. It remains to notice some unusual cases, such as that of aërial roots, produced by plants growing suspended or supported in the air, without either soil or water, and nourished by atmospheric vapour alone; of which the orchids are familiar instances. These have, as might be expected, a peculiar structure of the absorbing surfaces; but in other respects resemble ordinary roots. Then, again, there are the roots of real parasites, which insinuate themselves into the stems or roots of other plants, and abstract their nourishment wholly or in part from them. This parasitical habit is accompanied by other remarkable peculiarities, throughout the organization, of no practical importance for our present purpose; therefore it will be most convenient to proceed now to one of the most important branches of our subject, namely, the *anatomical structure* of roots, which is the only safe basis for a rational inquiry into the physiological laws presiding over the growth and development of these organs.

The root, as developed in the great majority of plants, presents a highly-organized structure, made up of various kinds of true cellular or parenchymatous tissue, together with those kinds of elementary tissue which, under the names of wood-cells, vessels, and ducts, form the hard parts of plants. As a rule, we may divide the internal structures of a root into two regions—the

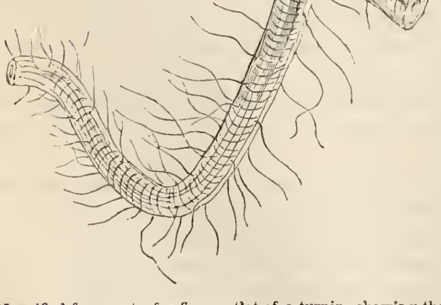
cortical and the woody or central region: the former of these is altogether parenchymatous, the latter consisting for the most part of woody tissue in natural roots, but containing abundance of parenchyma in plants where the roots become fleshy.

Fig. 8.



a, cross, and *b* perpendicular, slice of the root of a seedling carrot magnified sixty diameters. The central woody portion contains great quantities of ducts, and a delicate cambial layer intervenes between this and the rind.

Fig. 9.

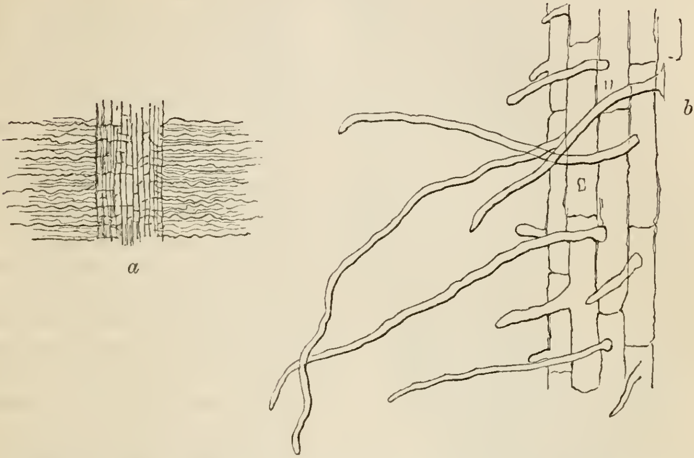


Magnified fragment of a fine rootlet of a turnip, showing the fibrils or radical hairs on the surface.

The *cortical* region (fig. 8) is continuous with the rind-structure of the stem, and in young roots consists of a thin layer of squarish parenchymatous cells, more or less densely filled with mucilaginous contents, but completely covered in on the outer surface by a layer of cells firmly connected side by side, forming a kind of skin, called the *epidermis.* This skin is distinguished from that clothing the leaves and young shoots, in accordance with the difference of function, by the absence of the peculiar breathing-pores or *stomata*, by which the internal structures of the leaves, &c., are placed in direct communication with the atmosphere. There are no openings of any kind through the skin covering the surface of roots; and the notion formerly entertained of the existence of sponge-like regions at the extremities of roots was an error arising out of imperfect observation, as will ap-

pear presently. The cortical region exhibits some striking differences in its subsequent history in different plants. In most cases, especially in the roots of Dicotyledons (fig. 9), and in the branching roots of Monocotyledons (fig. 10), many of the epidermal

Fig. 10.



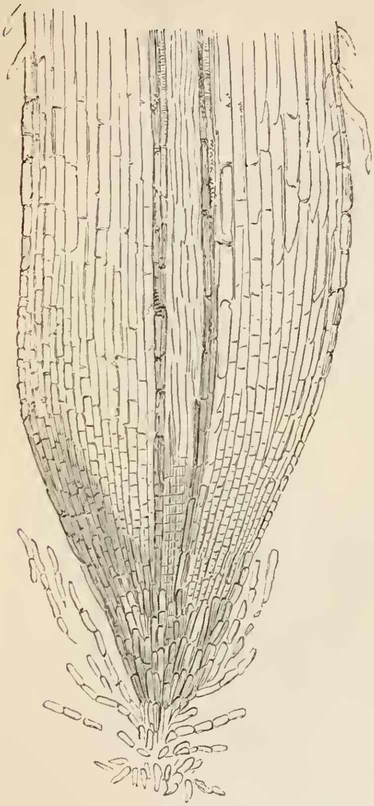
a, magnified fragment of a rootlet of barley, showing the fibrils; *b*, highly magnified epidermis of the same, showing the fibrils to be hair-like processes, produced from the epidermal cells.

cells, at a little distance from the growing point of the root or rootlet, grow out into filaments or hair-like processes, constituting the "*fibrils*" of roots. These are mostly invisible to the naked eye, and their presence is chiefly betrayed by the adhesion of the soil to them. When young roots are carefully washed and placed under a magnifying glass, these fibrils are seen very clearly; and on such roots as those of barley, for instance, they exist in enormous numbers.

At the growing points of roots, the epidermis passes insensibly into the mass of nascent or *cambial* tissue (fig. 11); but the growing point of a root is not at its absolute extremity, which is covered by a cap-shaped or hood-like portion of epidermis of its own, continuous likewise behind with the cambial structure. This cap-like sheath of the point of the root may be compared with the head of an arrow, forming a firm body, which can be pushed forward by the growing force behind, to penetrate through the resisting soil. This cap is subject to destruction and decomposition by external agencies, and is less distinctly seen in roots growing in earth than in those of aquatic plants. In all cases it is constantly undergoing renewal by cell-development at the backpart; and when it remains undissolved, as in many water-plants,

it becomes very large; when it undergoes decomposition in proportion as it is renewed behind, it presents an irregular ragged appearance, which probably gave rise to the idea of a spongy structure at the end of the rootlets.

Fig. 11.



Perpendicular slice of the end of a rootlet of barley, showing the dissolving cellular tissue at the point which has been mistaken for a spongy structure. Magnified 50 diameters.

In some roots the epidermis produces no *fibrils*, but remains smooth. This is especially the case in the delicate filamentous roots, annually thrown off, of many Monocotyledons, as of the onion, hyacinth, crocus, &c. In these roots the epidermal cells retain their general delicate character throughout their existence; and probably the roots of this character absorb by their surface throughout their whole length; while in woody roots the absorbent action is confined to the rootlets—to the regions near the growing points,—where the epidermis is still delicate and covered with its hair-like fibrils.

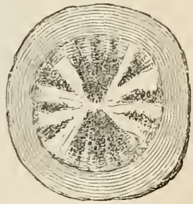
In woody roots, as the whole organ increases in size and the internal part becomes lignified, the cortical region changes its character. The epidermis dries up, and its place is taken by a corky structure, formed of two or three layers of the cells previously subjacent to the epidermis. When this change has taken place the direct absorbent power may be regarded as lost. Simultaneously with this change the inner cortical parenchyma often increases considerably in quantity, and this is particularly the case in fleshy roots, where this region subsequently becomes the reservoir of accumulated nourishment.

The centre of a very young root is occupied by a cord of cellular tissue of different form from the cortical parenchyma, consisting of elongated cells, the *cambium* of the future wood, which merges near the growing point in the focus of cell-

development, lying just behind the apex of the rootlet, where the nascent cells are all alike. The central cord very soon displays traces of the structures called ducts, and the cells assume the form, and more or less the substance, of the wood-cells of the stem. Some important differences exist as to the arrangement of their constituents in different classes of plants. In Dicotyledons, such plants as turnips, beans, pease, our native timber trees, &c., the structure of the central or woody part of the root differs from that of the stem chiefly in the absence of a central pith, together with the circumstance that the so-called vascular structure consists of short-jointed ducts, without the more flexible spiral vessels.

In ordinary Dicotyledonous roots, when no tuberous development occurs, the central woody structure soon acquires its distinctive character. The wood of the stem consists originally of a number of perpendicularly arranged cords, standing in a circle around the pith, a certain number of which pass out into each leaf to form the skeleton of those organs. The lower portions, inside the stem, extend down for a variable distance in different plants. Those of the lower joints of the stem run down into the roots to form its wood, so that here also we find the woody axis at first in the form of distinct bundles, separated from each other by cellular tissue (*medullary rays*), but crowded closely together in the centre, so that there is no pith. In the young root we find the bundles belonging to the cotyledons largest, between these the bundles belonging to a number of successive leaves. As the stem has its leaves developed the number of these bundles is increased, until at length a complete circle is formed (fig. 12). When the stem has its joints elongated the number of bundles extending down into the root is apparently more restricted than when the root is crowned by a tuft of leaves. The bundles belonging to the leaves, formed at a certain height from the root, have their origin at the points where some of the lower ones run out into the leaves, so that they take the place of the latter in the circle surrounding the pith.

Fig. 12.



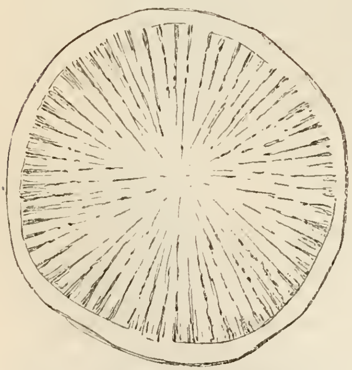
Cross slice of a young root of groundsel, showing the woody axis to be composed of wedge-shaped bundles separated by medullary rays. Magnified 10 diameters.

When the root is not tuberous, the woody bundles grow by the conversion of their cambial tissue into wood and ducts, and soon form a solid mass of wood, the wedge-shaped parts of which are more or less distinguishable in different cases. Sometimes the medullary rays separating them remain tolerably large; in other cases these are lost sight of, and the separate bundles are then often only roughly traceable by the arrangement of their larger ducts.

The woody axis thus formed, exhibits at its outer surface (next the rind) a *cambium*-region, where new development of wood takes place, as in the stem, in perennial plants forming annual rings, and where the buds giving rise to branches originate. But when we proceed outwards from here we miss the next constituent of the stem, namely, the *liber*, or bast fibres, which are absent from the root, ending at the "collar," or point of junction of the root and stem. On the other hand, the cellular structure of the rind or bark is mostly very much developed, and is renewed on the inside by the cambium region, in proportion as its outer parts are destroyed. The outer part of the rind of oldish roots exhibits a corky texture, and in the roots of trees this rind acquires great solidity, forming a kind of false corky bark if the roots are exposed.

Where the roots of Dicotyledons become tuberous, very different departures from the regular structure are met with in different plants: for example, in the turnip and its allies, the carrot, parsnip, &c., and the beet or mangel-wurzel. In the first group the unnatural production of succulent cellular tissue takes place in the medullary rays which invade and break up the woody bundles, and scatter their elements so that they are found distributed in irregular radiating rows in a great mass of parenchymatous tissue (fig. 13). This tissue is by no means a continuation of the pith of the stem, although it bears some resemblance to it. There is a distinct boundary of wood where the root joins the stem. This is probably of importance as regards the "keeping" qualities of the roots. In the carrot (fig. 6) there is a similar development in the woody region, but not so marked; while an equal, if not greater, production of parenchyma takes place on the outer side of the cambium, forming a thick fleshy rind. A thickened rind of this kind is found in most of the fleshy, fibrous roots of perennial herbaceous Dicotyledons—such as groundsel, primrose, &c.

Fig. 13.



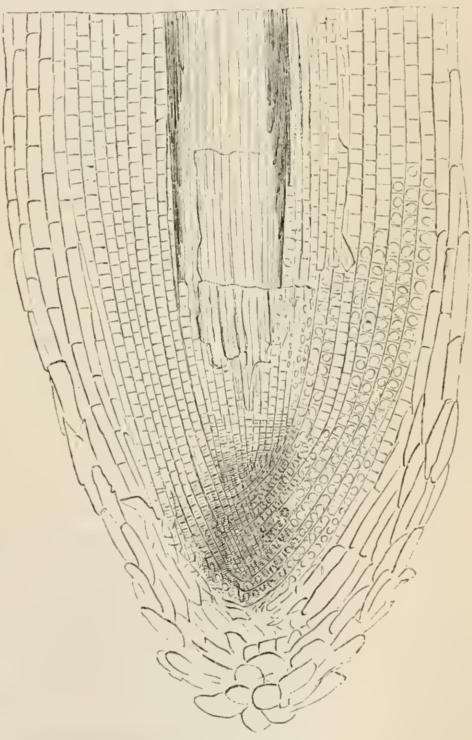
Cross slice of a young turnip, showing that the tuberous structure exists in the wood, breaking up and scattering the fibro-vascular structures, which appear in radiating lines, but are most developed near the circumference where they adjoin the rind.

In the beet, the structure both of the stem and root is unlike that of ordinary Dicotyledons, and the changes produced by cultivation cannot be discussed here.

The roots of Monocotyledonous plants—such as those of grasses, onions, ordinary bulbous plants, &c., are temporary struc-

tures, thrown off year after year, or dying with the stem in annuals. Their woody structure differs very much from that of the roots of Dicotyledons, so that they are easily known by observing a cross section; but the cortical region and the growing extremities differ little in the roots of the two classes. The principal characteristic of the roots of the Monocotyledons lies in their woody central cord exhibiting no trace of distinct bundles separated by medullary rays, but consisting of a central column of wood, with its "ducts" or vascular structures lying on the outside, at the region where the wood adjoins the cortical parenchyma. A kind of *cambium* exists here also, although no annual rings are ever formed, since it is at this outer surface of the woody region that the root-buds originate.

Fig. 14.

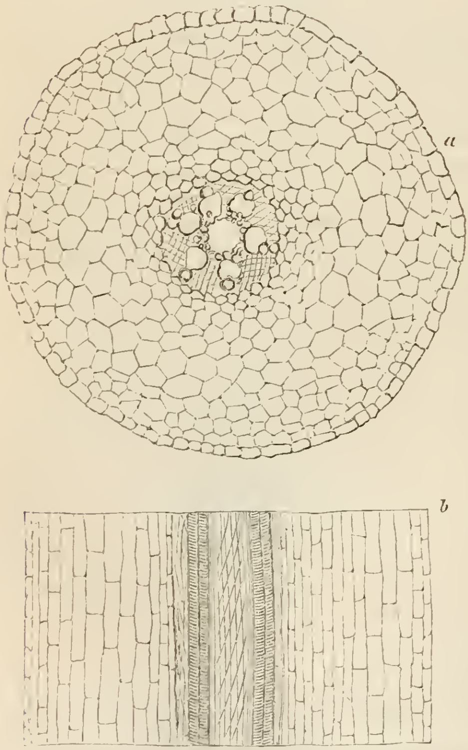


Perpendicular slice of the end of the rootlet of the onion, magnified 100 diameters.

The structure of the ordinary roots of herbaceous Monocotyledonous plants may be well examined in the onion. If we place an onion bulb over water in a long glass, like a hyacinth glass, it soon sends out a number of slender blunt-ended roots, of white colour, the tips only having a yellowish tinge. By placing longitudinal sections of one of them under the microscope, we can trace the mode of development of their roots. The extreme point (fig. 14) is clothed by irregularly-formed cells, loosely coherent, and evidently being partly thrown off by expansion of the structure beneath; these cells pass laterally into a stratum of elongated cells, which clothe the whole external surface of the rootlet. In the interior of the conical end of the root we find a mass of nascent cells, with their walls scarcely distinguishable, in a state of rapid multi-

plication by division ; this is the chief focus of development of the root. Continuing the examination upward to the older part of the root, the rudimentary cells are soon found arranged in rows parallel to the direction of the root ; at first they are very short, then squarish in the side view, and by degrees they are elongated until their length is much greater than their breadth ; they also expand laterally to a certain extent after their first formation ; but this growth ceases, so that the rootlet has a fixed diameter. The cell-division seems to be repeated in these cells in the direction of their length after they have attained their full diameter. While young, near the tip of the root, they are densely filled with protoplasmic substances ; as they expand they appear clearer, and contain only a moderate quantity of protoplasm, with abundant watery cell-sap. The rudimentary cells developed in the very centre of the point of growth become cells of much less diameter and more elongated form, and constitute the rudiment of a fibro-vascular cord running through the centre of the rootlet ; at a little distance from the point, traces of spiral markings may be detected on the walls of some of these cells, which are becoming *vessels*, the distinguishing marks of the fibro-vascular bundles. Higher up in the root, the central fibro-vascular cord is clearly recognizable, surrounded by parenchymatous cells, themselves enclosed by a continuous layer of delicate epidermal cells (fig. 15). In these roots the epidermal cells do not grow out in hairs (radical fibrils).

Fig. 15.



a, cross, and *b* perpendicular, slices of a root of the onion, magnified 50 diameters. In the centre is the fibro-vascular axis, with the ducts on the outside.

Roots of this kind show very clearly that the elongation of roots takes place by increase at the point only. This is seen by noticing the relative dimensions of the cells in the different parts, but it may be proved still more evidently by marking the roots, when of some length, at equal distances, with touches of Indian ink. When we watch the farther growth of a root thus marked, we see that the spots on the upper part of the root do not become removed to a greater distance from each other, but new structure is added on below the marked parts. The same important law of growth is illustrated by the natural marks made by branches arising from the roots, which remain permanently at their original distance apart, as may be clearly seen in the transverse streaks on the surface of the root of a carrot.

In the seeds of the grasses, of which we may select barley as an example, the radicle or rudimentary root is a minute, blunt, conical projection at the base of the embryo, which itself is situated at one side of the bottom of the farinaceous mass of endosperm which forms the great bulk of the seed. A germinated seed of barley exhibits the valves of the husk open more or less at each end, the leaves emerging in front, and several delicate thread-like roots at the other. Removing the husk, the leaves are found to arise from a thickened place or knot previously contained within the husk, the part of the stem below this knot ending in a blunt process, which is the undeveloped radicle; the filamentous roots have been pushed out from the base of the cotyledon, between the point of the radicle and the knot. The root filaments present characters similar to those of the onion, but differ in the presence of abundance of branches and *fibrils.* From this peculiarity, such roots possess greater vitality; for if a root of an onion is injured at its extremity, its growth is entirely arrested; while the rootlet of a grass injured at the point may freely develop lateral branches, like the roots of Dicotyledons.

The general observations upon roots contained in the present paper, have been prepared as introductory to a detailed account of the development of agricultural roots. The observations upon the turnip are tolerably complete, and will be shortly submitted to the Society.

XXI.—*Horse Labour in France.* By F. R. DE LA TREHONNAIS.

THE use of horses for agricultural labour is rather limited in France. In most of the midland and southern districts oxen and even cows are used by the peasants to draw their ploughs, and perform other operations of husbandry. Indeed, such a

custom is for them a sheer necessity. If we look at the slow growth of their breeds of cattle, the difficulty of feeding them for the butcher, the want of root crops and other artificial forage, it is obvious that the farmers are obliged to get something besides manure and meat out of their cattle, and that is labour; for were it not for this, no French farmer could keep a single cow in the districts above mentioned, the return in meat, milk, and manure being totally inadequate to repay even the scanty keep which is provided for them. In fact there are few districts in which a farmer can breed, rear, and fatten. There are departments where stock-farming principally consists in breeding calves, which are sold to other provinces where they are brought for labour, and when old they are sold to other districts where they are grazed. In very few places are these operations combined, owing to the scarcity of fodder (itself a natural consequence of a scarcity of manure), and the slow growth and coarseness of the breeds.

In Normandy, where horses are bred and cattle grazed, it is difficult to ascertain the value of horse labour, because every farmer is a horse-breeder and dealer, and seeks to make a profit in that branch of trade. The French government, in order to encourage improvement in the breeds of horses, grants a premium, varying from twelve to twenty pounds, to the owner of a good stallion approved of by the Government Inspector, and besides, every season there are sent to various districts stallions from the government establishments, called *Haras*, which serve brood mares at a trifling charge.

In Normandy horses are fed in the usual manner with hay and corn when at work, and when out of work they are turned into the pastures to graze.

From this want of uniformity in horse-keeping, as regards agricultural labour, it is impossible to give anything like a correct estimate of the cost of horse-keep in Normandy, but it can differ very little from what it is in other districts to which I shall presently allude.

In the department of Seine et Marne, not far from Paris, where high farming may be said to be as well understood and practised as in England, I know a gentleman holding 550 acres, whose course of cropping is the four-course system. He keeps 15 horses and 16 oxen. Every year he fattens and sells off 8 oxen; so that his ox teams are renewed every two years. In summer his horses work from five o'clock in the morning to seven at night; the times of rest being half an hour or three quarters of an hour at seven in the morning, from eleven till one at noon, and half an hour or three quarters at four in the afternoon. In winter the labour continues from half-past eight till half-past four. These

horses average in value 38*l.* per horse from four to six years old; after that age they lose about 6*l.* in value each, every year; their annual expense in harness and shoes is about 3*l.* each. As to their food, it is extremely variable; but taking the average price of hay and corn, it may be put down at 2*s.* per day; this year it is fully 2*s.* 6*d.* Oxen on the contrary cost only about 10*d.* a day, owing to the abundant supply of mangold pulp obtained from a distillery erected at the joint expense of three or four neighbouring farmers. It is reckoned that four oxen are equal to three horses: 9*s.* 6*d.* a week is about the wages of a labourer.

For another department, that of Aisne, I am enabled to enter into more precise details. Formerly, when the course of cropping consisted of alternate wheat and bare fallow, it was considered that four horses and one driver were sufficient for about 120 acres; but the cultivation of beet-roots to supply the sugar manufacturers has since wrought such a beneficial change in the mode of husbandry in that district, that an improved system of tillage, deeper cultivation, and more frequent manipulation of the soil, together with carrying roots to the factory, and bringing back pulp as fodder for the cattle, have necessitated a more numerous team of horses. The same team of four horses and one driver are therefore now required for every 80 acres in cultivation; that is, one horse per 20 acres.

An eminent agriculturist in that department informs me that he keeps 21 horses and 15 oxen for about 400 acres, the agent's riding-horse included. They are kept in the following manner:—

In winter they have each per day

6 quarts of oats.
5 lbs. of grass hay.
5 lbs. of clover hay.
2½ lbs. of wheat straw.
1 bundle of bean straw.
1 lb. of bran.

The whole is cut, bruised, mixed, and fermented, together with ¼lb. of salt for each horse, twice a week.

In summer the only difference is the increase in the quantity of oats, from 6 to 10 quarts.

The working oxen are fed in the following manner:—

56 lbs. beet-root pulp.
2½ lbs. grass hay.
4½ lbs. clover hay.
4½ lbs. cut straw.
2½ lbs. bruised barley.
3½ lbs. rape or linseed cake.

The whole is cut, mixed, and fermented as above, with a dose of salt twice a week. In winter the oxen work the same time as

the horses; in summer those that work in the morning rest in the afternoon, and thus work only half a day.

Every year the stables are debited—

1st. The value of the team fixed at the preceding inventory, in which the decreased value of the horses was taken into consideration.

2nd. The repairs of implements, waggons, harness, shoeing, veterinary attendance, losses, &c.

3rd. The consumption of food.

4th. The straw and other litter.

5th. The attendance of the drivers and stablemen.

6th. The due proportion of stable and other building rent, taxes, repairs, &c.

They are credited—

1st. The debtor's side of the preceding inventory.

2nd. The value of the manure at per load.

3rd. The amount of sales in horses and fattened oxen.

From all these items it is reckoned that the average cost of a horse or ox's day's work is 2 francs 92 centimes, about 2 shillings and 5 pence, exclusive of resting days.

The oxen draw with a collar like horses, and are used even in the shafts, but principally for ploughing, and drawing the thrashing-machine, and when necessary for carting also. Horses are principally employed in carting when the state of the weather does not allow working on the land.

Another eminent agriculturist from the same department, a member of the Council General, has given me the following information:—

Small holdings employ 1 horse for about 12 acres; and large holdings 1 horse for about 20 acres, which tallies with the preceding statement. A good draft horse receives per day—

1st. From 8 to 9 quarts of oats.

2nd. 14 lbs. of grass-hay, clover, or lucerne.

3rd. 14 lbs. winter vetches, beans, or rye, according to the season.

4th. At different times during the year a certain quantity of meal and bran.

5th. 16 lbs. of wheat straw.

All these items, calculated from their average prices, would bring the cost of one day's feeding to about 1 franc 76 centimes, equal to 1 shilling and 5 pence.

The corn is generally given whole, but the mode of bruising it, and cutting the hay, straw, &c., into chaff, is getting more and

more prevalent, and is thought to effect a saving of one-fifth in the quantity of fodder; but my informant thinks that the expenses attendant upon the increased labour of preparing the food must nearly absorb the whole of that economy.

The yearly expense of a horse can thus be reckoned as follows:—

	£.	s.	d.
Food	25	13	9
Groom's attendance	0	16	0
Farrier and harness-maker	1	4	0
Veterinary and physic	0	2	6
Interest on average value of 18*l*., and decrease in value at 15 per cent.	2	14	0
Losses, accidents, &c., at 3 per cent.	0	10	9
Stabling	0	12	0
	£31	13	0

The manure from a horse is calculated at double the weight of his food, which amounts to about 160 cwt.; and its value at 50 centimes a cwt. is about 3*l*. 4*s*., which being deducted from 31*l*. 13*s*. leaves a net cost of 28*l*. 9*s*. for each horse.

In France there are about 60 holidays in the year, to which must be added about 35 days of compulsory rest from bad weather, such as rain, snow, &c., and 25 days of indispensable rest during the full tide of employment; these would leave about 245 working days, at an average cost of 2*s*. 6*d*. per day.

Drivers are paid at the rate of 10*s*. 6*d*. per week.

In hilly districts, such as Limousin for instance, horses are very little used for agricultural labour, oxen being the prevailing power. The department of Haute Vienne, which comprises about 250,000 acres under cereal cultivation, does not possess more than 20 teams of horses for agricultural purposes. Two oxen can plough about one-third of an acre per day; a pair of horses a little more than one acre, say one acre and one-fifth, but of course the ploughing is very shallow. One pair of oxen costs with the driver about 2*s*. 6*d*. a day; the pair of horses, driver included, about six pence more. The number of working days in the year is reckoned at 270. The cost of keep for a horse is reckoned at about 16*l*. a year, which for 270 days would give about 1*s*. 2½*d*. per day.

We add to this the substance of an interesting communication from Mr. Van den Bosch, of Wilhelminadorp, near Goes, Holland, descriptive of his experience in horse-labour on one of the polders * of South Beveland. The extent cultivated amounts to

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* A "polder" is an enclosure embanked from the sea.

2790 acres. The force employed consists of 97 working horses and 18 young horses, the property of the tenant, and 24 hired horses nearly all the year, besides 16 horses hired during spring and summer. In all it is estimated at 64 pair-horse teams. The rotation of crops, in accordance with the best practice of Belgian agriculture, includes a series of no less than 20 years, as follows:—1. Fallow (manured); 2. Rape (for seed); 3. Wheat; 4. Roots; 5. Beans or Peas; 6. Wheat; 7. Oats (sown with red clover); 8. Clover; 9. Fallow; 10. Winter Barley; 11. Madder (manured); 12. Madder; 13. Madder; 14. Peas or Flax; 15. Wheat; 16. Roots (manured); 17. Summer Barley (with clover and grass-seeds); 18. Clover or grass; 19. Pasture; 20. Pasture.

One-fifth only of the land is thus in clover or grass each year, and the remainder (2230 acres) is cultivated, being only 35 acres per pair, a much less extent than is commonly cultivated per pair in England. It should be added that, in addition to the above-named extent of arable-land, there are 225 acres of permanent pasture-land on the farm; and when comparing English experience with that of South Beveland, it should also be borne in mind that the character of the winter season there is such that 300 days of work per annum, which is possible in England, is impossible in Holland. Winter is usually much more severe there, and horse-work is stopped for 2½ or 3 months, during which time horses only get "different kinds of straw as fodder uncut." As soon as work begins again in March or the end of February they receive some hay and rather more than a bushel of oats and a bushel of beans each weekly till the month of May, when spring work is over, and then they are put to pasture when not at work, though a little hay is still given. During June, July, August, and till the middle of September, they are thus at pasture in the night, while in the day cut clover is given to them in yards. During the latter end of September cut carrots are gradually substituted for the clover, and half the spring quantity of oats without beans is given. This continues till December, when the work is finished for the season, and no more corn is given.

The quantities consumed by the 97 home-fed horses are stated as follows:—

2300 bushels of oats (24 bushels each),
1000 bushels of beans (10 bushels each);

besides 6 acres of oats, 6½ acres of beans, 18 acres of carrots, ½ an acre of mangel, and hay, clover, and pasture unspecified. The valuation according to the prices of the locality is stated thus:—

	£.	s.	d.
Pasture	320	7	0
Hay and clover (mixed)	246	6	0
Oats	174	10	0
Beans	131	16	0
Oats from field	26	12	0
Beans from field	30	15	0
Carrots	145	6	0
Mangels	3	18	0
Amounting in all to	£1079	10	0

Or 11*l.* a-year each.

Valued at the rates named in Mr. J. C. Morton's paper on horse-power, the account would stand as follows:—

	£.	s.	d.
2300 bushels of oats, at 3*s.*	345	0	0
1000 bushels of beans, at 5*s.*	250	0	0
6 acres of oats (50 bushels per acre, at 3*s.*) ..	45	0	0
6½ acres of beans (32 bushels per acre, at 5*s.*)	52	0	0
18 acres of carrots—250 tons (?), at 10*s.* ..	125	0	0
½ acre of mangel—15 tons (?), at 6*s.* 8*d.* ..	5	0	0
Hay—5 tons per week (?) for 30 weeks, at 3*l.*	450	0	0
Clover and pasture—5 tons a-day (?) for 100 days, at 10*s.*	250	0	0
In all	£1522	0	0

Or more than 15*l.* each.

This latter statement, however, is made in ignorance of the exact daily consumption of the several items specified. The former is given on Mr. Van den Bosch's own authority, and he says, "All the facts and averages mentioned are drawn up from our bookkeeping." Among other items given to us is 730*l.* as the annual payment of the ploughmen and their food—a sum evidently much below the annual wages which would in this country be paid to the men working 97 horses, even though for only nine months in the year. It should be added that the figures here stated are descriptive of the period between 1841 and 1850. The figures of more recent years have also been supplied to us, but no material change is shown by them to have occurred.

In addition to these particulars descriptive of the polder, Mr. Van den Bosch has been good enough to give the history of a smaller farm. It consists of 150 acres of arable land, besides permanent pasture, and 7 horses are employed upon it. A 20 years' rotation is adopted here also, in which, however, only one year of naked fallow is allowed, and four years pasture are taken in succession at the close of the series. One quarter of the land is thus in grass each year, and there is a remainder of 32 acres

per pair of horses for cultivation. The annual cost of food consumed per annum is stated to be 82*l.* 15*s.*, or 11*l.* 16*s.* apiece—very nearly the same as in the former instance—and the wages to ploughmen are put at 49*l.* 2*s.* 6*d.* The horses are stated to be worth about 10 guineas each. The ploughing is done for the most part by two horses to a team, excepting in fallowing and during autumn, when three horses are sometimes used per plough. The depth of cultivation is 4 to 6 inches for 2-horse ploughing, 8 to 10 for 3-horse ploughing. The quantity ploughed per day with 2 horses, for light ploughing (less than 4 inches deep), is 2 acres; and for common ploughing at least 1¼ acres. The ploughing (ribbing) in ridges for turnips, potatoes, and madder, is got over at the rate of 3 acres daily per pair-horse plough. The soil of the polder is described as being one-eighth part nearly pure sand, the remainder a clayey loam, varying from very stiff heavy soil to light loam. The soil on the small farm is a good clay loam. It is added, in reference to the rotation named as being adopted on the polder, that fallow (1st year) is taken after breaking up of the 3-year old pasture (20th year), partly for the rape which follows it, and which ought to be dunged even in rich soils, and partly because it affords opportunity to bring manure upon the land in June, when there is a great deal less to do than in spring. "However," says Mr. Van den Bosch, "since 1856, we are gradually changing in our polder this rotation for the other one adopted on the small farm, giving up rape after fallow, and trying to bring the manure on the land early in spring for beans."

XXII.—*Statistics of Live Stock for Consumption in the Metropolis.* By Robert Herbert.

It has long been a matter of surprise, not only in this country, but more especially on the Continent, with what apparent ease the vast consuming powers of the great metropolis are met by the agricultural body. Year after year our markets are amply supplied, without producing much influence upon price—in other words, without depressing the quotations beneath what may be termed a paying point. Our ports are open to the admission of foreign stock free of duty, yet the effect is but little felt: a powerful competition has existed between the live and dead markets; nevertheless, prices rule high, when compared with some former years. The first question which we propose to consider is, What are the breeds of beasts and sheep which form the supplies exhibited in London? From a careful analysis of

the stock exhibited during the past year, and founded on the most careful observation, we have arrived at the following conclusions:—

Percentage of Beasts shown in the Metropolitan Market in 1858.

Shorthorns	33·00
Herefords	9·25
Devons	5·00
Longhorns	1·00
Crosses	16·00
Highlanders	2·00
Polled Scots	4·00
Ayrshire	0·25
Irish crosses	8·00
Welsh runts	1·50
Irish	9·00
Bremen, Tonning, Dutch, and German	9·50
Spanish and Portuguese	1·50
	100·00

The above table shows that the short-horned breed of beasts now stands at the head of the list of stock for what may be termed general consumption. They have gone on progressing at a wonderful rate since the commencement of the present century, and they are now to be found in almost every county in England as well as in Ireland and Scotland. We may further observe that half-bred beasts, between the Scots and short-horns, have considerably increased within the last twenty years; indeed, the breeds, almost generally, have undergone important changes. To show this, we direct attention to the annexed statement of the percentage of the bullock supplies shown in Smithfield Cattle Market in the year 1838:—

	Percentage.
Shorthorns	30·00
Herefords	13·00
Devons	11·00
Longhorns	2·50
English crosses	13·00
Highlanders	3·00
Polled cattle	10·00
Ayrshire	6·00
Scotch crosses	1·50
Welsh runts	10·00
	100·00

The changes in the various breeds, then, in twenty years, have been remarkable. Whilst the short-horns and crosses have increased, the Herefords, Devons, long-horns, and polled beasts have declined considerably. The same may be said of Welsh runts; but we find a great increase in Irish crosses, no doubt with the short-horned breed imported from this country, and

the old, or pure native, breeds of Irish beasts, which were formerly so much valued for *their hides*, are now nearly extinct. The decrease in the *pure* Scotch breeds of cattle grazed and fed in England may be attributed to the increased production of turnips in Scotland. Previous to the year 1838 the pure Scots were chiefly sent to England for artificial feeding in Norfolk and Suffolk. Since that year the Scotch breeders have fed them themselves, finding the cross with English breeds—short-horns and, in some instances, Herefords—produce much more weight and an earlier maturity. Even the black polled beasts, by many considered prime Scots, are first crosses from short-horned bulls.

Having shown the various changes in the production of cattle for consumption in the Metropolis, we have now to consider those which have presented themselves in the supplies of sheep in the period already indicated, viz. during the last twenty years. In the past year the percentage of sheep exhibited in the great metropolitan market was about as follows. We say *about*, because it would be impossible to define accurately the various crosses, as even many of the Lincoln sheep are not pure breeds, being mixed to some extent with Leicesters and Gloucesters. The percentage, then, runs thus:—

Sheep shown in the Metropolitan Market in 1858.

	Percentage.
Lincolns	27·00
Leicesters	25·00
South Downs and Hampshire Downs	10·00
Crosses	15·25
Gloucesters and Gloucester Downs	8·00
Kents	5·00
Scotch	1·00
Irish	3·00
Dutch	4·50
German	1·00
Spanish	0·25
	100·00

In the year 1838 the percentage was as under:—

	Percentage.
Lincolns	31·00
Leicesters	29·00
South Downs	12·00
Crosses	13·00
Gloucesters and Gloucester Downs	6·00
Kents	5·00
Scotch	2·50
Irish	1·50
	100·00

Having shown the fluctuations in the percentage of stock exhibited in 1838 compared with 1858, we have now to direct attention to the demand for, and value of, live stock in the metropolitan cattle market during the past six months. In that period the consumptive demand has increased—the quality of the supplies has been tolerably good, though not to say first-rate—and the quotations have ruled remarkably firm. But it may be observed that nearly the same state of trade prevailed in the corresponding periods of the five previous years, as will be seen by the annexed comparative table:—

AVERAGE PRICES of BEEF and MUTTON in the LAST SIX MONTHS.

Per 8 lbs., to sink the offal.

—	1853.	1854.	1855.	1856.	1857.	1858.
BEEF:—	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Inferior beef	2 8	3 2	3 4	2 10	2 10	2 10
Middling ditto ..	3 8	4 0	4 2	4 0	3 10	4 0
Prime ditto ..	4 10	5 0	5 2	5 2	4 10	5 2
MUTTON:—						
Inferior mutton ..	2 10	3 2	3 6	3 6	3 0	2 10
Middling ditto ..	4 0	4 0	4 2	4 4	4 2	4 0
Prime ditto ..	5 2	5 0	5 0	5 4	5 4	5 2

With the exception of 1853, the supplies of beasts exhibited in the last six months of 1858 were largest, and those of sheep were tolerably good, as is thus shown:—

SUPPLIES of each kind of STOCK EXHIBITED and SOLD in the LAST SIX MONTHS of the following Years:—

—	1853.	1854.	1855.	1856.	1857.	1858.
Beasts	149,008	136,216	133,577	138,309	137,915	147,118
Cows	3,191	3,157	3,185	2,864	2,948	3,137
Sheep and lambs	860,800	853,020	751,818	689,444	701,414	746,839
Calves	17,058	16,490	14,810	14,280	15,006	15,186
Pigs	15,284	19,531	22,350	18,733	14,992	19,441

This statement shows that the supplies of both beasts and sheep exhibited last year were somewhat extensive. We find, however, that in the last six months of 1853, 149,008 beasts and 860,800 sheep were on offer, against 147,118 of the former and 746,839 of the latter last year in the same period; but this deficiency has arisen from the enormous trade now carried on in the wholesale dead meat markets, which draw largely upon our agricultural districts, as well as upon Scotland. This compe-

tition is likely to continue, as it is much less expensive to forward meat to London than live stock; besides which, the offal is frequently worth more in the provinces than in the metropolis. In concluding this Report, we have to direct particular attention to the annexed statement of what may be termed the "district" bullock supplies for the metropolitan market in the last six months.

"District" Bullock Supplies.

—	1853.	1854.	1855.	1856.	1857.	1858.
*Northern Districts ..	54,650	55,200	52,800	60,760	81,600	66,260
Eastern ditto ..	8,650	3,400	3,000	..	7,000	6,970
Other parts of England	15,500	16,500	11,050	20,700	15,370	13,820
Scotland	4,728	2,817	2,993	2,734	1.836	2,674
Ireland	7,412	7,000	8,200	8,364	5,840	13,860
Foreign	38,192	36,333	35,418	33,381	25,984	30,797

This table shows that, in the last six months of 1858, 66,260 beasts reached the above market from the Northern districts, against 81,600 in 1857; 60,760 in 1856; 52,800 in 1855; 55,200 in 1854; and 54,650 in 1853. Ireland furnished the largest number on record; and from other quarters the supplies were liberal.

5, Argyle Square, St. Pancras, London.

XXIII.—*An Essay on the Management of a Herd of Breeding Cattle, with especial reference to the kind of Diet, the Treatment, and Condition best calculated to ensure regular Fecundity and successful Gestation, and the Causes which operate adversely in particular Seasons.* By William Wright.

The consumption of beef is undoubtedly on the increase, and it becomes therefore of great importance to inquire by what means the supply can be kept equal to the demand—how the best quality may be produced—and in what way the breeding of cattle may be made profitable.

A perusal of the tours of Arthur Young, published a century ago, will show that the feeders of cattle for the butcher were then only to be found dispersed at wide intervals over the country; and though the importance of obtaining good breeding stock was not wholly unknown, it was not until within the last half

* In the Metropolitan Cattle-Market the "Northern Districts" are understood to include the counties of Lincoln, Leicester, Northampton, and Warwick; the Eastern Districts include Norfolk, Suffolk, Cambridgeshire, and Essex.

century that the subject received the attention it deserves. The efforts of agricultural societies throughout England have, at a much later period, been worthily directed to the encouragement of the breeding and feeding of cattle, and the importance of the subject is now sufficiently admitted. I make no apology, therefore, for endeavouring, in a plain, intelligible manner, to offer some practical remarks on the general management of a herd of breeding cattle, and on the mode practised upon my farm at Sigglesthorne, in the district of Holderness.

To trace the progress of the various breeds which are now to be found in the British islands, though exceedingly interesting, would be beside the object now in view; nor is it desirable at present to discuss their relative merits. Climate and variety of situation must influence the choice, and experience will select that breed which is found most profitable in the farmer's hands. It has long been a disputed point as to which is best; but if a world-wide reputation be the test, the "improved short-horns" are decidedly entitled to carry away the palm. I therefore propose to confine my observations to this breed. It had its origin in the judicious blending of the blood of other breeds; and to do it justice a full history of the earlier herds would be required. Public opinion has, however, long since put its seal upon the superiority of the short-horns; and no further explanation, therefore, can be needed of my choice of them when about ten years ago I commenced laying the foundation of a small herd, less with reference to dairy purposes than to obtain early maturity, and in order that the best meat might be produced at the least cost.

My attention was first directed to house accommodation, and ever since I commenced the breeding, rearing, and feeding of cattle, every effort has been made to remove the bad and ill-adapted houses, and in their place to supply, at the least cost combined with efficiency, such accommodation as might be provided by a safe and profitable outlay.

The farm consists of 194 acres, 65 of which are grass, all thoroughly underdrained. The observations of Mr. Caird, published in 1851, on the mode of farming in Holderness, encouraged me to proceed with confidence in my experiments and improvements. He says, at p. 304 of his work entitled 'English Agriculture in 1850 and 1851,' that the want of—

"drainage and accommodation for live stock appear to be the chief defects in the farming of this district—drainage, which will render an additional expenditure of manure a profitable outlay; and better housing for stock, in which the increasing breadths of green crops may be consumed with economy both of the substance of the animal (by shelter and warmth), and of labour, by convenient arrangements to facilitate the operations of the feeder, and by preventing waste of the *roots*, and other expensive substances em-

ployed in feeding. An extension of this system will of course lead to larger home supplies of manure, and consequently to heavier crops of all kinds; and there can be little doubt the farmers of Holderness will be compelled, by a lower range of prices of corn, to direct their attention, more than they have hitherto done, to increasing their returns from live stock, whether in beef, mutton, or wool, or in cheese and butter."

To expect, after purchasing my herd (for which considerable prices were given in order to attain purity and excellence), that it would improve under a system still too common of imperfect accommodation, would have been absurd indeed; I therefore resolved on erecting an entirely new shed, and other appropriate buildings, covering two open yards, which, with a few surrounding cattle-sheds, were all that formerly had been provided for the stock. An isometrical view, together with a plan and elevation of the covered homestead and farm-buildings, are annexed, and the following enumeration of the parts corresponds to the figures on the plan.

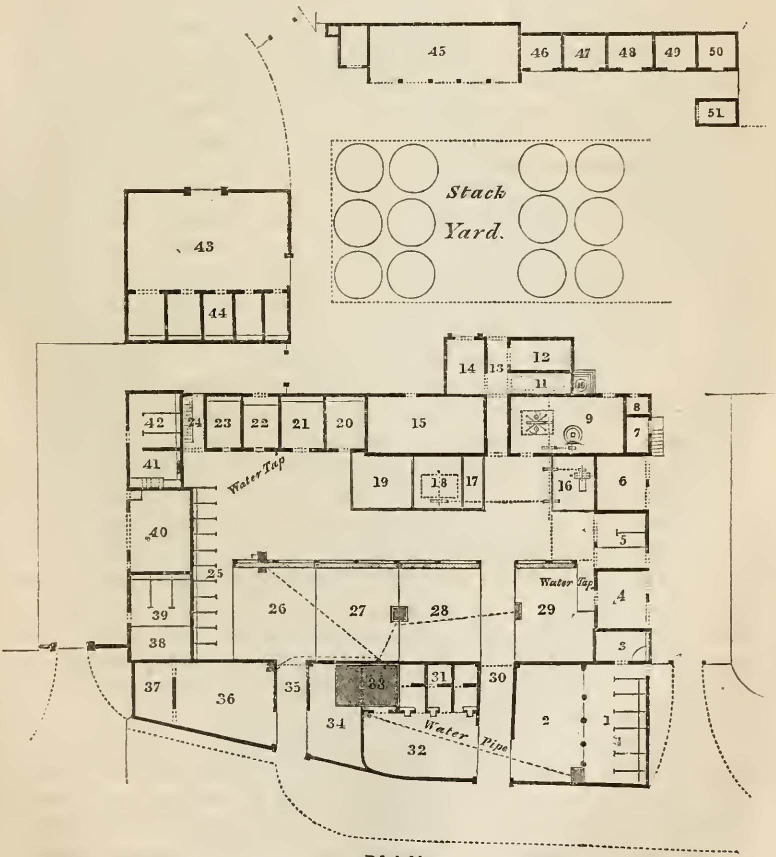
No. on Plan.	Description.	No. on Plan.	Description.
1	Draught-horse stable.	26, 27, 28, 29	Cattle-pens.
2	Yard.	30	Entrance.
3	Harness-room.	31	Piggeries.
4	Loose box.	32	Yard.
5	Loose boxes.	33	Cistern.
6	Implement-house.	34	Cattle shed and yard.
7	Cake-house and granary above.	35	Entrance.
8	Tool-house.	36	Cattle-yard.
9	Mill-house.	37	Cattle-shed.
10	Chimney.	38	Loose box.
11	Boiler.	39	Coach-horse stable.
12	Cooking-house.	40	Coach-house.
13	Entrance.	41	Saddle-room.
14	Coal-house for engine.	42	Ride-horse stable.
15	Barn.	43	Bull-yard.
16	Cutting-room.	44	Loose boxes.
17	Chaff-house.	45	Waggon-shed.
18	Corn-room and thrashing-machine on floor above.	46	Implement-house.
19	Straw-room.	47	ditto.
20, 21, 22, 23	Loose boxes.	48	Joiner's shop.
24	Entrance.	49	Calf-house.
25	Cow-bars.	50	Poultry-house.
		51	Drill-house.

No expense was spared to make everything as useful as possible. The cost thus incurred, exclusive of the materials of the old farm-buildings, which, being sound and in good order, were either

PLAN AND ELEVATION OF THE COVERED HOMESTEAD
AT SIGGLESTHORNE HALL,

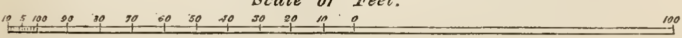
BELONGING TO WILLIAM WRIGHT, ESQ.

ELEVATION.



PLAN.

Scale of Feet.

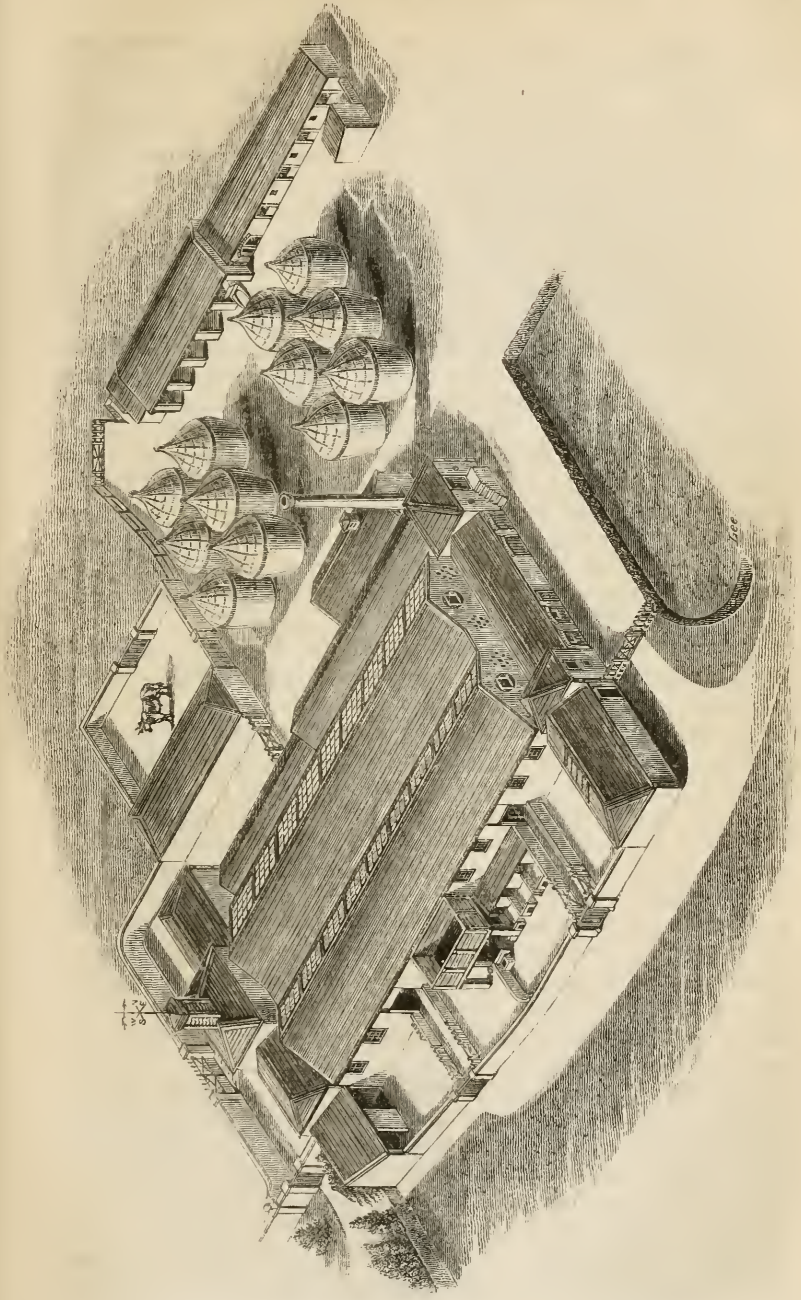


either allowed to stand, or were worked up in the new erections, was—

	£.	
"For the shed, cistern, and draught-horse stable ..	480	as per contract.
For chaff-house, corn-room, partition of pens, thrashing-floor, chaff-house, and cutting-floor	50	
For extra lead lining for large cistern	50	
For 6-horse steam-engine, complete, and 4-horse thrashing-machine and corn chaff-cutter ..	200	as per contract.
For cost of water-troughs	20	
For engine chimney and brickwork for boiler and coal-house	200	as per centract.
For sundries, including pair of stones for grinding corn	70	
Total..	£1070"	

The shed referred to in the foregoing account is 148 feet long by 83 feet wide, and is divided into two spans of roofing 25½ feet high. On one side of it, and adjoining a barn and other erections, the steam-engine, of 6 horse-power, is fitted up, to thrash, cut, grind, steam roots, and perform other useful duties: the other parts of the shed are devoted to the cattle in pens, holding from six to ten each. In the roof at the south end, in order to equalise the temperature, ventilators and lights are placed, so constructed that they can be partially closed or opened, or in severe weather altogether shut, as may be required: this is done by means of Russian matting, arranged so as to be easily raised or let down. The cattle are arranged in the 4 pens in the manner considered best to promote cleanliness and comfort; in one are put weaned calves or yearlings; in another calves and their dams; in the third the in-calvers; and in the remaining pen the feeding bullocks and heifers, and the small or loose boxes are devoted to the use of such of the cattle as may require them. It will thus be seen that the habits of all are consulted, and, as far as possible, their happiness promoted; and as they are all (except the old ones) members of one family, and all born on the farm, the stronger beast is seldom found to exact, as is so commonly the case, from his weaker neighbours more than his proper portion of the food. Any tendency of this kind, if it is ever shown, is prevented either by removal or chaining to a side post, means at once simple and effectual, but seldom necessary.

The breeding stock, all under cover, consists at the present time of 25 cows and heifers, 35 calves of various ages, 1 bull, with another for change if required, and 14 feeding beasts for market next autumn, the practice being to have always a draft of two-year-olds, weighing from 50 to 70 imperial stones, to go off



ISOMETRICAL VIEW.

off about September in each year. As experience shows that cows are disposed to be quarrelsome, a small number are tied by the head, being those used for dairy purposes.

It is generally admitted that "short-horns" have less disposition to milk than to feed, which my experience has confirmed. When, therefore, there is a deficiency of milk, the young calf is taught to take its food from a crib, contrived for the purpose, apart from its dam, but having at the same time free access to her. To provide for uniformity in the rearing of calves, two are allotted to one cow with a good udder, generally without the help of artificial food, but always carefully arranging for the supply to be made good if there be any deficiency. The herdsman by observation and practice has then no difficulty in managing so that the whole of the stock is kept in a growing and improving condition. It is amusing to observe the perfect acquaintance which he has acquired by daily intercourse and observation with each of the breeding stock. A love for his work has made him perfectly contented and happy in possessing a thorough knowledge of all under his care; and, assisted through the winter season by a stout lad, he feeds and attends to the whole herd without further assistance except in extraordinary cases, which will be mentioned in another place.

The advantage of the covered yards for the cattle cannot be over estimated; the health and comfort of the labourer are likewise secured; he is always dry and warm, and never interrupted, as under the old system, by the rains and storms of winter. Care is taken to have the straw, chaff, cut meat, meal, oil-cake, and roots, always at hand, the shed accommodation being such that there is ample room for all that may be required; and the routine of thrashing and cutting chop, once or twice a week, finishing the day with grinding the corn to be used, is found amply sufficient for the purpose. The cattle are kept clean in the pens with a little straw bedding, and the manure is left to accumulate until wanted, the liquid being absorbed, and nothing wasted or lost, as is frequently the case in the old farmyard or cow shed; and by means of a cistern and a ball-tap and trough to each pen a plentiful supply of water is always available.

The front of each crib is fitted up with a moveable manger, to rise with the elevation of the manure, which frequently attains to four or five feet; and at the back of each crib, against the wall, a straw rack is fixed, also moveable if required. As the cattle trample over the mass of manure, it becomes consolidated and of the best quality, and when removed has the appearance of a solid black uniform mass. No disagreeable effluvium arises from it, nor is there ever any heating,—visitors

having often remarked that the odour was rather agreeable than otherwise. The manure made on the premises is ready for immediate use on removal, for any crop that may require it.

I now come to speak of the treatment and food which the cattle receive during the winter. Although, as before stated, the herd is kept up by me with a view to profit chiefly as a feeder, yet occasional sales are made of heifers or bull-calves for exportation, or to other breeders of cattle if found equally profitable, thus not limiting sales solely to the butcher. No attempt, however, is made to take rank with the great names so well known as prizemen at the leading agricultural shows, but in a more humble way to connect the management of the herd with improved agriculture.

The roots consumed are principally Skirving's swede, with a small quantity of mangold-wurzel. The hay and clover produced, being limited, is given in small quantities to the calves, and to such cows as are either out of condition or suckling two calves. With the chaff-cutter a fresh supply of chop is obtained daily, and to each of the herd according to age is given from 2 to 4 lbs. of ground beans, barley or oats, or an equivalent in cake or a mixture of both, and a plentiful supply of straw is put into the racks; and having observed from experience that the animals prefer to pull for themselves, the chaff or cut straw is confined to one feed a day, at the time when the meal is given out, the two being mixed together. Cut roots are also supplied, the quantity being regulated by the stock on hand. The above food is given when few roots are allowed, and a reduction is made in proportion as the roots are increased. Turnips are cut by hand as wanted. The stock is found healthy and improving throughout the winter season upon this diet; and as a little extra food is allowed towards spring, they may be termed "very fresh" when they are turned out to graze. Towards winter the cattle are brought in on the first stormy or cold night, which is commonly about the early part of November, and they remain up until May, or nearly seven months of the year; the practice being not to turn them out until the weather becomes fine. It is most important that they should not be allowed to remain out too late in the season, or to go out too early. The practice of turning out cattle to eat straw in the open fields in frosty weather or when snow is on the ground cannot be too strongly condemned. The starved appearance of animals so treated shows that every principle on which the success of the grazier depends is being sacrificed. No wonder that losses occur with such management, or that the well-bred cow rapidly deteriorates, her progeny becoming constitutionally weak and failing to develop the points most hoped for. Experience has

shown—as all who try will prove—that wholesome food and warmth are true economy in the rearing and breeding of cattle.

Heifers are usually put to the bull at two years old; sometimes, but very rarely, before; and this arrangement is found most conducive to the fruitfulness of the animals. The bulls used are fed on meal, either of barley or beans, or a mixture of each, along with hay and turnips and a small quantity of oil-cake, not exceeding 2 lbs. per day, as it is found that much oil-cake is unfavourable to their usefulness; but with gentle exercise no difficulty has been found to arise with the bull thus treated. Moderately fed, say on 4 lbs. of meal, half a basket of cut turnips, a little hay, and the cake in the quantity mentioned above, he thrives well without getting too fat. Too much stress cannot be laid on his proper treatment in this respect, otherwise serious loss and disappointment may ensue. A mixture of food is proved by experience to suit both sexes the best, and is found to produce both health and fruitfulness. I have often felt surprised at the high condition of some short-horns which have come under my own observation, and which have nevertheless bred with regularity healthy calves; but I am of opinion that a medium condition is the most successful. Exercise in the pens is also most beneficial to the cow during pregnancy, and should be allowed whenever possible. It is a most injurious practice to tie up breeding animals: it prevents the proper circulation of the blood, and causes disease or malformation; and healthier and stronger calves are dropped from cows which have not been tied up. When the time approaches for calving the cow is removed from the pen and put into a loose box: the instinct of the animal is to seek retirement, and her feelings are consulted in this respect; and although a watchful eye is kept over her whilst in labour, it is found imprudent to disturb her, except to render that assistance at parturition which may be necessary to ensure a speedy and safe deliverance. Formerly great excitement prevailed when the "cow calved," and it is not surprising that milk fever and other complaints succeeded the bustle and excitement of that occasion. Under the present treatment, however, except when some unnatural event arises needing the assistance of the veterinary surgeon, it very seldom happens that any loss ensues.

The sympathy of a breeding herd is one of the most interesting subjects for discussion. I have known instances of a whole herd becoming "infected" with casting their calves, and serious loss has followed for several years, scarcely any of the cows going to the end of their time without this taking place. I have always found the best remedy to be to remove any cow

that shows the slightest symptoms of this affection and hide it from the rest, for, if they are allowed inspection or opportunity for sympathy to act, it is certain to spread. This infirmity is not considered to be influenced solely by the season; it occurs usually, in the first instance, from accidental causes, and it is only when allowed to spread that it becomes serious in its results; much, however, may be done by proper management and diet to prevent its entrance into a herd, still more to hinder its prevailing to such an extent as, if uncontrolled, it may be expected to reach. The propensity has its origin sometimes from the too free use of turnips in severe weather, combined with sudden changes of temperature; I am not, however, prepared to assert this to be an ordinary cause of abortion; only some half-dozen cases, and those at long intervals, having arisen during the whole of my experience.

Although, as already remarked, high condition does not prevent cattle from breeding, it is nevertheless obvious, that to feed a bull until his activity is lost is unwise, a medium weight being the best and most successful. I have known a bull fed on tares or other succulent food suffer the loss of his usefulness, and great caution is required to avoid a too free use of such food. I do not, however, refrain from giving the bull a little clover or Italian rye-grass in summer; on the contrary, I believe it to be very beneficial when in combination with hay and dry food.

The diseases of cattle are numerous, but I shall notice those only which tend to the destruction of the healthy breeding condition. The pulmonary diseases common in some localities have their origin, in a great measure, from insufficient shelter, irregular feeding, or improper food, aggravated by infected, dirty, and unhealthy houses; but these diseases, which if neglected generally prove fatal, may be prevented with success, by adopting the suggestions which have been offered in this paper. The suckling of calves in winter is often attended with a loss of milk, from their imperfect action in drawing it completely off, and, as every cowkeeper knows, a cow that has never suckled a calf is always preferred for dairy purposes; but calves cannot be brought up so well or so conveniently without allowing them to follow their dams; and it is only required of the herdsman, while the calf is young, that he be vigilant in seeing, when the evening milking time arrives, that the superfluous milk is removed. In the shed this is not troublesome, but when out at grass the neglect of the herdsman in this particular may occasion the serious loss of one or more teats; many a valuable cow has been thus condemned to the butcher, which otherwise might have been preserved in as thriving and breeding

condition as the others. Care is likewise especially necessary, when the animals are turned out to grass, that they do not eat too much of the fresh grass after living so long on dry food; and it is better to commence grazing by degrees. I have almost abandoned the use of physic after a cow has calved, as uncalled for unless there are unhealthy symptoms; for the less nature is tampered with the better, so long as its processes go forward regularly. During the summer, and while the cattle are out grazing, they are much less affected with constipation or indigestion than when indoors and living on a dry diet, and when straw must form one of the principal items of food. When any symptoms of fever appear, it will be found that a dose of half a pound of coarse Epsom salts, with a pound of treacle and a table-spoonful of ginger, is a safe and useful medicine, and may be repeated, after a day's interval, as a simple and generally efficacious remedy. A watchful eye in the herdsman will often discover an ailment which, nipped in the bud, prevents the commencement or spread of disease; and although I by no means wish to convey the idea that this is "a cure-all," or that the services of the intelligent practitioner may be altogether dispensed with, yet much may be done to make his visits less frequent than they otherwise would be. As regards diet, I may say, that I have tried almost every known "food for cattle," excepting indeed those kinds so often advertised under this especial title, which I always studiously avoid: and I have judged for myself upon the relative qualities of the different articles used, such as locust-beans, maize, pulse, corn, and cake. A word on linseed-cake may be appropriate here, as the attention of farmers generally cannot be more profitably given than to the procuring of a genuine article—not merely one free from adulteration, but which is made from pure linseed. The acrid and deleterious seeds so often imported in linseed are probably the occasion of much injury to the animals, besides destroying or delaying the feeding process. I would therefore urge consumers of cake to buy a good article: depend upon it they will ultimately find it to be the cheapest and best. Several celebrated farmers and breeders of stock, viz. the late Mr. Bates of Kirkleavington, the Messrs. Booth, Colonel Towneley, Mr. Ambler, Mr. Torr, of Aylesby, and many others, have always been most particular in their selection of the purest quality of linseed-cake.

The smallness of the calf of a high-bred short-horn at birth is remarkable. In several instances within my own knowledge they have not been more than half the size of those of coarser breeds; but their rapid growth soon supplies this deficiency at birth. As my herd is not kept up for public exhibition, the calves are not forced or fed beyond what may be considered

the limits of profit; at the same time they are not kept low; indeed it would be shortsighted to do this; and as they are intended for early maturity, great care is bestowed upon them from their birth, in order that they may make steady progress, and it is seldom if ever that any disappointment occurs unless when there is disease to contend with. I have had extraordinary instances of early maturity: last summer a steer of a year old showed all the development of muscle, bone, and flesh of a two-year old. This bullock had been suckled for three months, and had thereby "kept its calf-flesh," and gained a step in advance which it did not lose. Allusion is made to this case of precocity, in order to show what a profitable investment a wellbred, well-fed, and well-attended calf may be made. The weight of this bullock, when in the field at a year old, was estimated at 50 stones of 14 lbs., which, at the then marketable price of beef, 8*s.* 9*d.* per stone, gave 21*l.* 17*s.* 6*d.* as its value. This fact is submitted for the consideration of those farmers who think of bringing up their calves on old milk, or who otherwise stunt them in their growth: and I would ask them on which side lies the profit?

The use of phosphate of lime as manure on a farm where the breeding of cattle is the chief object is of great importance, for not only do the old but the young cattle prosper when a free use of bones is supplied either to grass or root-crops. For many years the dairy farmers of Cheshire have been greatly benefited by the use of bone-dust, and I have found that, after such a dressing has been given to the grass-land, the cattle have been remarkably vigorous and healthy. Wherever impoverished ill-looking animals are found there is probably a want of this invaluable ingredient in the herbage. A dressing of ground bones, bone-ash, or superphosphate, is a necessary and important part of good and successful management. The quality of the hay or clover grown on land so dressed is much more valuable to the cattle than that grown with ordinary manure. This has been realised in a great degree on the Wold farms in this neighbourhood, on which large flocks of sheep are sustained where the land was before nearly useless; and on old sward lands which seldom receive any manure except what the animals drop during the summer, the addition of a top-dressing of bones would be equally beneficial. A field of grass-land which had been exhausted, and which I found almost useless (the stock put into it hardly holding their own), after a dressing of 7 cwt. of ground bones per acre, carried one half more stock, combined with great improvement in the state of the stock themselves at the end of the summer. This outlay a tenant farmer may safely make, as the return with profit is immediately before

him. I know many prosperous farmers who act on this principle, and, if they do not use bones, keep double the stock and make up for what the land will not carry by a liberal use of corn or linseed-cake. All grazing land is improved by the use of bones, and therefore it becomes an easy question of money value whether it be not profitable to graze, say at the rate of half a beast to the acre more by the use of bones, the cost price being, for 7 cwt. of half-inch ground bones 2*l.* 9*s.*, which, lasting five years at the least, is on the average about 10*s.* per acre. Most graziers will admit that an outlay of 1*l.* is not likely to leave a loss for a summer's run for a bullock. My management therefore includes bone manure as indispensable when success and profit are looked for in keeping a herd of breeding cattle. The grass land in Holderness appears naturally to contain a fair proportion of phosphate, and is in consequence highly favourable for the rearing of calves, otherwise it would cease to keep so great a number of cattle, year after year, as it now does; little, if any, manure being applied.

I now come to speak of summer management. When the time has arrived for the cattle to be turned out to graze, each joyfully sallies forth to the pasture: if the nights immediately following should be cold, the beasts are brought into shelter, but as soon as the weather permits they are allowed to remain out altogether. Summer soiling has been found unprofitable: it causes much labour and expense of cartage and attendance, and can only prove valuable under peculiar circumstances, such as where the land is near a town, where much clover is grown, or where there is little pasture land. A visit made to the water-meadows of the Duke of Portland, near Mansfield, in the year 1854, verifies my statement in this respect; the bulk of hay there grown was certainly large, but the quality greatly inferior; the "cattle do not thrive upon it," answered the herdsman in reply to my inquiry as to its intrinsic value as compared with ordinary meadow hay; no doubt it has a value, but certainly not for fattening purposes.

Young stock are put on clover, consisting of the usual mixture of grass-seeds intended to be grazed; and in order to prevent *hoven* by too great a quantity being quickly consumed, they are at first allowed to graze only for an hour, or at the most two hours; but the time is gradually extended until they remain out altogether with the rest of the cattle on the pasture lands, and no artificial food is given to the herd while grazing, except to such as are being fed for the butcher, and to cows with two calves suckling them. The value of the bone dressing before spoken of now comes into use, as it allows of a greater number of stock being grazed per acre. I keep my bulls in loose boxes

during the summer, not from objection to their grazing, but to prevent accidents. On some farms it is more convenient to adopt the latter course, and it is no doubt better that the cows should remain with the bull than be brought up to him at the homestead.

The high price which some of our principal breeders of short-horns have lately obtained for prize animals for exportation to Australia, the United States of America, Canada, and the Continent of Europe, requires a passing thought. During last autumn I had an opportunity of inquiring of a gentleman, himself an extensive grazier in Australia, how far these high-priced animals repaid their spirited importers: he stated that they were highly profitable, as all trials of pure short-horn bulls, or of crosses with them, had been attended with eminent success. The late Earl Spencer, who was celebrated for his fine herd of cattle, stated his belief, when the free admission of foreign cattle under the late Sir Robert Peel's tariff created such a groundless panic, that a sale of pure breeds for exportation would spring up. It is now patent to all how correct his Lordship's anticipations have proved. I have myself recently shipped off five heifers in calf to Mr. Hepner of Jan Kowno, near Burnberg, in Prussia; and he tells me that a lively desire is now showing itself in his country to replace the old breeds with short-horns. That this feeling extends to other parts of the Continent may be fairly presumed, and it will no doubt lead to many profitable transactions. The progress of nations in their habits and tastes may be slow, but that the love of a good joint is spreading upon the Continent is affirmed by many well-informed and highly respectable correspondents. I might furnish some interesting and valuable statements, supplied to me by friends in Canada and the United States to whom I have shipped cattle; but it will suffice to affirm that they all agree in the utility and success attending the exportation of cattle. Let us hope therefore that those spirited individuals who embark in this enterprise may live to see their efforts crowned with success. That it will ultimately be so there can be no doubt; the great facilities of intercourse and the growing wants of people of other nations for better diet must compel them to seek for that which with us is indispensable, though with them a luxury or almost beyond reach.

The place allotted to the young calves is now changed from close and narrow spaces in a calf-house to large and spacious pens having a free current of pure air, where they have abundance of room for exercise; and consequently not one loss ensued during the whole of last winter, while under the old system frequent

losses occurred; those fed from the kit being in a healthy state, and there is likewise less risk of the calves swallowing hair balls, made from licking each other, as is commonly the case when they are kept in small and confined spaces two or three together.

I now come to the question of profit and loss in the management of a herd of high-bred short-horns, and would first remark that, as my herd is kept up mainly because it affords me pleasure, I am bound to credit the account with the value of the enjoyment derived from the work. That the "hobby," if I may be allowed so to term it, may be made an expensive one, those who have tried to keep a herd chiefly on bought food have found to their cost; and unless there is a sufficiency of land to work along with the stock, to make a return for the manure in corn and root crops, it is vain to expect anything but a heavy loss in the balance sheet. There are those who have profitably bred short-horns, but they are the comparatively few whose attention has been exclusively devoted to it. As stated by Mr. Caird, many farmers have found that it is unprofitable. For my own part I could not recommend any one who makes everything subservient to his herd, and whose sole attention is given to it, to expect immediate profit. It requires long and careful attention, much judicious and persevering crossing, to arrive at *mediocrity*, and there are very few who attain to the supreme excellence of breed possessed by those gentlemen who carry off the prizes year after year at our leading exhibitions.

It must be admitted, however, that success will certainly accompany good breeding *as a part of general farming*, though it may be doubtful when too exclusively attended to; I would therefore recommend farmers to cultivate with greater attention the best breeds, and not by indifference and neglect produce inferior species: by so doing they would ultimately benefit. The disappointment which breeders so often realise is owing to their having expected at once to find their practice profitable. I believe it may be fairly estimated that it requires at least ten years before a profitable return can with certainty be looked for. I may remark, however, from personal experience, that under any circumstances good cattle with proper and efficient management will pay the breeder much better than bad or inferior stock.

Having briefly explained the practice adopted by me in the rearing and breeding of short-horns, and having alluded to the importance of the use of linseed-cake in the economy of the feeder, I will conclude with some observations upon its manufacture, drawn from accurate and reliable sources, which may prove acceptable and useful to the agriculturist.

The official returns of the imports of linseed into the United Kingdom show a large and yearly increase, as appears by the following Table, viz.:—

Year.	Quarters Imported.	Year.	Quarters Imported.
1841	363,461	1850	608,984
1842	367,700	1851	630,471
1843	470,539	1852	799,402
1844	616,947	1853	1,035,335
1845	656,793	1854	828,513
1846	506,141	1855	756,950
1847	439,512	1856	1,180,179
1848	799,650	1857	1,100,000
1849	626,495		

In 1857 the supply was derived from the following sources: viz. from Calcutta 90,000 quarters, Bombay 120,000, St. Petersburg 190,000 quarters, Archangel 60,000, Riga 75,000, Memel and other places in the Baltic about 80,000 quarters; the Black Sea 410,000, Alexandria and various other ports 60,000 quarters. It will, therefore, be observed that the largest portion of the linseed is drawn from Russia, and a plentiful or an indifferent harvest of linseed throughout that empire is felt by the consumer of linseed-cakes here in a higher or lower range of prices consequent thereon. He also suffers from the inferiority of quality caused by the admixture of seeds other than linseed, so that he has to pay for an indifferent article at a higher price. The 1,100,000 quarters of linseed imported in 1857 would produce 137,500 tons of linseed-cake (worth at 10*l.* per ton 1,375,000*l.*); and this is in addition to the foreign cake annually imported, amounting to about 100,000 tons. The total value of linseed-cake consumed in this country may, therefore, be estimated at about 2,000,000*l.* annually. The East Indian qualities in general are tolerably even, seldom varying to any appreciable extent at the respective ports of shipment. They yield the greatest quantity of oil, and after pressure the cake is no doubt more nourishing and valuable than any other. But the bulk of the supplies is furnished by other countries more subject to variation of climate, and uniformity of quality in different seasons is not obtainable. Inferiority in quality is usually accompanied by adulteration, a variety of seeds being found mixed with the linseed, such as wild rape (*Brassica campestris*), wild mustard or charlock (*Sinapis arvensis*), seeds of *Lolium perenne*, of dodder (*Cuscuta epilinum*), and of willow-weed and millet (*Panicum miliaceum*). The bulk of the linseed being imported from the Black Sea, the standard of quality and price is chiefly regulated by the importation from thence. In good seasons the Black Sea linseed is bold and pure, with only a small ad-

mixture of other seeds; and if the Greeks, in whose hands this article is now to a great extent centred, were not to tamper with it, the importation would leave little if any room for objection. But during the late Russian war, and indeed down to the present time, adulteration has been carried to such an extent, that a deputation of seed-crushers, appointed at a general meeting of that body with a view to redress this evil, waited upon the principal Greek houses in London. The interview, however, resulted in a total failure of the object desired to be brought about, for the deputation, on being shown a sample of pure linseed, and also one containing the admixture complained of, and being requested to state their opinion what price such linseed, on arrival here, would command in the market, were forced to admit that competition for seed amongst the crushers had much influence over the quality of the article supplied, and that the ready sale which could be found for an inferior quality removed all inducement from the seller to ship a genuine article. To the high price attained during the last two or three years, coupled with inferior quality and quantity arising from bad harvests, may be attributed the deterioration of quality in linseed. The crusher, aiming at uniformity in his manufacture, but more especially to suit the tastes of his customers, has no doubt in some instances been induced to add to the already large accumulation of extraneous matter, so that, when the cake is crushed and ready for use, it cannot always be said to be LINSEED-cake.

Our brethren across the Atlantic have studied the art of manufacturing linseed-cake. What they produce is faultless to the eye, and, if not always perfection to the taste, it is thin, tender, flaky, and finds a ready sale in this country at the highest market price of the day, the question of genuineness being left entirely for subsequent determination. The cake pleases the eye and is always in good demand; and what more is required? Farmers have only themselves to blame in this respect. A considerable quantity of cake is now used for feeding sheep, and for this purpose cake of a tender kind, such as this, is preferred: *it is produced by the addition of bran in its manufacture.* Thus the farmer has to pay 10*l.* or 11*l.* per ton for cake which pleases the eye in this country, but omits to consider that for this he has to pay dearly for the admixture of bran, which costs 4*l.* or 5*l.* per ton, and in the United States probably about half that price. The intrinsic value of linseed-cake is not sufficiently dwelt upon; hard-pressed cake, or cake which is closely ground, although genuine, is invariably refused by the farmer, and preference given to the more tender-looking but adulterated kinds. My own bailiff I have observed is inclined to the latter-mentioned quality of cake, espe-

cially for sheep. It, however, requires little if any consideration to decide where the preference should be shown. The difference may be discovered by the greater amount of mucilage which a given quantity will produce, which may be quickly and easily tested. If a ton of cake contain one-third of bran, it may be readily detected. Crushers are not always at fault; I have no hesitation in saying that they have, in some instances, received directions from their customers to mix bran in the cake, "as they preferred its being done, alleging that it made it more free." The temptation, therefore, under which the crusher finds himself does not always spring from self-interest on his part, or self-protection against those who adulterate to a much larger extent, but often from the extensive demand and ready sale for the spurious article. The intelligent farmer will, however, be found testing his sample by the simple method above named, and valuing it by its intrinsic worth, before he makes his purchase. The still greater adulteration practised by some crushers, who gather up everything that can be made to pass as linseed-cake, is one which requires less exposure, for the farmers who purchase such an article must do it with their eyes open, and cannot complain if they have to suffer for their folly.

I am indebted to a correspondent in whom I have the greatest confidence, for the following information respecting the different qualities of linseed-cake. He states that the finest quality is made as follows :—300 lbs. of ground linseed are mixed with 28 lbs. of ground nut-cake, 28 lbs. of rape-cake (also ground), and 28 lbs. of coarse bran. The second qualities are made of a small admixture of linseed with a considerable part of the under-mentioned articles; and the third qualities are made wholly of the last named of the following articles, without any linseed at all :—

Foreign linseed-cakes,	Castor-oilnut cakes,
Dodder-seed cakes,	Rice-husks,
Poppy-seed cakes,	Cotton-seed cakes,
African ground-nut cakes,	Rape-cakes.

Sometimes the whole of the above are mixed and worked together; but a supply of each is not always on hand; and some or all, according to circumstances, are introduced to make up the desired quality.

I am as unwilling as I am unable to attach to the fair and honest manufacturer of linseed-cakes any participation in such practices. He has nothing to fear from exposure, and therefore the following Table of calculation of the money value of a ton of linseed-cakes, made to suit a cheap customer, will not affect him, but, on the contrary, will prove to consumers what compe-

tition the crusher who makes cakes from linseed has to contend against, and will, I trust, be the means of inducing the purchaser to give a fair price for an honest article. I will premise that the articles named are at the relative values at which they usually stand to each other, so that, if linseed-cakes are lower in price, the others are likewise lower in proportion, and *vice versâ* :—

Cost of 1 ton of cake composed of the following articles :—

	£.	s.	d.
5 cwt. of soft green rape-cake at 6*l*. per ton	1	10	0
5 cwt. of bran, large flaky quality, at 4*l*. 10*s*. per ton	1	2	6
5 cwt. of nut-cake at 6*l*. per ton	1	10	0
5 cwt. of fine linseed equivalent to a like quantity of genuine cake, and worth 10*l*. per ton	2	10	0
	6	12	6
Market value of 1 ton of genuine linseed-cakes made from Bombay, Black Sea, or Baltic seed, is	10	0	0
Difference in value	3	7	6

The temptation, therefore, to manufacture a compound similar to the above finds greater inducement when cakes are high in price ; but the growing disposition to purchase such a quality must also be taken into consideration. If the price of linseed falls, as it probably will do, to a level with former averages, the inducement will be less ; and the quality of the new crop is so very superior as to render adulteration less profitable. The samples of the new crop are fine and clean, so that it may be reasonably hoped that the supply henceforward, especially from Russia, will be both abundant and good. The value of linseed-cake as food for cattle has been so often set forth in this Journal, that it is unnecessary for me to say anything in recommendation of it ; it enters so much into the economy of almost every farm, that to obtain a cheap and ample supply of the genuine article should be the desire of every farmer who wishes to improve and sustain his farm. The increasing imports from the East Indies afford room for hope that the wants of the grazier will to some extent be met thereby. The vast regions in that portion of Her Majesty's dominions capable, when opened out, of yielding linseed, leave no room for doubt that a large and annually increasing supply of seed will find its way into this country from thence, and thus enable the agriculturist to manufacture his own manure, feed his cattle, and ultimately improve the condition and quality of his land, to the profit and advantage both of himself and his landlord.

In closing my remarks on this subject, I will add that it has been my endeavour throughout to show, in a spirit of fairness, how the question stands between the crusher and his customer. That he is in no way answerable for deficient harvests or defec-

tive quality will be readily admitted; and if the demand for a spurious article supports and encourages its manufacture, the blame does not rest with him entirely. On the other hand, is it honest or consistent with the infallible principles of right and wrong that such a state of things should continue? The growing importance of the article to the feeder of cattle, and its yearly increasing extent, forbid it: there is no plea either of present profit or expediency that can justify it. It is as unfair to the crusher who does not adulterate, as to the consumer; and the sooner it is abandoned the better for all parties concerned. There is a wide-spread belief that no crusher is an "honest miller." This I need scarcely say is far from being true: but unfortunately the odium is shared alike by the honest and dishonest trader. There are undoubtedly many who have suffered severe losses in contending against unfair competition rather than manufacture a dishonest article, and others who have begun well, but have been unable to resist strong temptation; and before I conclude I will mention an amusing anecdote illustrative of this point. An honest or rather once honest miller, living near to a neighbouring crusher, had for some time sold him all his bran, but he saw and envied the crusher's thriving trade, and resolved upon turning his refuse to a more profitable account, and accordingly erected presses adjoining his flour-mill that he also might manufacture linseed-cake out of BRAN! I dare say when they meet they can afford a mutual smile.

Sigglesthorne Hall, Holderness, Yorkshire.

XXIV.—*On Liquid Manure.* By AUGUSTUS VOELCKER.

THERE is scarcely any agricultural improvement so excellent that it could be carried out with advantage in every locality, nor any agricultural practice so intrinsically bad that it could justly be condemned unconditionally. If it were not so, we should find it difficult to explain reasonably how it is that certain modes of culture which by most men are considered antiquated or irrational should yet have a powerful hold on the minds of some skilled and experienced farmers.

It is true that agricultural improvements make their way but slowly into ordinary farm-routine, but, on the other hand, it must be confessed that any scheme, however visionary, meets in this country with eager advocates, whose extravagant ideas induce some people to introduce into practice suggestions which in other countries are only known in theory.

Experiments on a variety of agricultural subjects are nowhere so extensively tried as in England. Many of these experiments, though on the whole unsuccessful, are nevertheless of great advantage to the farming community, for they often bring to light matters of real practical importance, or at any rate act as beacons to warn others not to engage in unprofitable speculations.

The great success which has attended the application of liquid manure in Flanders is proverbial, where it produces most astonishing effects upon soils that are almost completely barren. Any one who has passed through Belgium, and examined the nature of the soil, must have been struck with the wonderful change which liquid manure has produced; and perhaps he may ask why such a profitable system of applying manure to the land is not adopted more extensively in other countries. Men zealous in devoting their best energies to the good of their countrymen have never been wanting in England, and it is but natural that at various times admirers of the Flemish system of agriculture should have raised their voice in favour of liquid manure. Indeed, expensive experiments have been set on foot in this country with most praiseworthy zeal in order to convince the British agriculturist of the benefit which, in the opinion of some, liquid manure is capable of securing to the farmer.

I am sure the agricultural community is much indebted to men like Mr. Mechi, Mr. Kennedy, Mr. Telfer, and others, for their exertions to adapt the Flemish system of liquid manuring to the peculiarities and advanced condition of English agriculture. And though many may differ as to the extent to which irrigation with liquid manure may be carried out, no one can deny that on some farms in this country it has produced surprising crops.

In other places, however, liquid manure has not been so successfully employed, and in some cases its application has proved a complete failure.

Some instances have come under my personal observation in which considerable expense was incurred for the erection of tanks that now are deserted, experience having shown that no good whatever was produced by the application of liquid manure to the land. There can be no reasonable doubt that this conclusion is well founded on fact, and that there are soils which are not benefited in the least by its use.

It must be borne in mind that the system of liquid manuring can no longer be regarded as an agricultural novelty, but that it has been tested on a large scale under the most varied circumstances. At the best its success has been but partial; and as the necessary arrangements involve a great outlay of money, it becomes a question of importance to decide whether on a particular farm it is likely or not to be more remunerative than the

ordinary methods of applying manure to the land. The solution of this important question is difficult, since it is complicated by considerations of a purely practical kind. Means of procuring the necessary amount of water for the proper dilution of liquid manure do not exist everywhere, or can only be devised at a ruinous expense; it is, moreover, still a question with our best agriculturists whether the expenses which have to be incurred for erecting steam-engines, constructing liquid-manure tanks, and laying down a network of distributing pipes, are commensurate with the result. It is not my province to touch the question in this aspect; practical considerations of this kind are much better left in the hands of those who have a more immediate interest in the cultivation of the soil, and who are in a much better position than myself to form a reliable opinion on questions that involve considerations of pounds, shillings, and pence.

But apart from the purely practical difficulties that stand in the way of properly estimating the merits of liquid manuring, there are several points which justly belong to the province of the agricultural chemist. It devolves upon him to ascertain on what principle or principles are based the astonishing effects which liquid manure produces in some instances, and to endeavour to explain the reasons why in others it does no good, or is attended with but partial success. The question of profitable return for the expense of proper arrangements for the distribution of liquid manure is one for after consideration; it may overrule or not the theory which informs us that in the liquid form manuring constituents are most conducive to the rapid development of certain kinds of agricultural produce. But in the first place we have to examine carefully whether this doctrine can be accepted unconditionally, or whether this very generally received opinion has not to be modified in a considerable degree. A principle like that which informs us that fertilising matters produce their maximum effect in a liquid form may be true in the abstract, or with reference to particular kinds of plants, or in certain climates, or with reference to soils of a particular character; but in other climates or other soils there may be operating causes which render it by no means advisable to administer manuring matters in a state of solution.

Having given of late much attention to this subject, it is my purpose to give in the following pages my views on the utility of introducing the system of liquid manuring into ordinary farm-practice. I would premise, however, that I wish the present article to be considered in the light of an attempt to explain the somewhat conflicting experience with respect to the application of liquid manure.

It will, I think, be admitted by every one that, under the name of liquid manure, fertilisers of widely different characters are applied to the land, and that probably the differences in the observed effects of liquid manure may be due, at least to some extent, to its variable composition. It will therefore devolve upon me, in the first place, to point out the composition and fertilising value of several descriptions of liquid manure which I have selected for examination, and to show how far differences in composition influence the effects which it is capable of producing in the field.

In the next place I propose to examine the circumstances in which liquid manure is employed with decided advantage, and to attempt giving an explanation of the causes of success.

In the third place I shall discuss the characters of soils upon which liquid manure produces no beneficial effect, and state the reasons of failure; and

Lastly, I propose to offer some remarks on the means of disposing of liquid manure.

I. On the Composition and Fertilising Value of Liquid Manure.

Liquid manure, it need hardly be observed, may be produced in a variety of ways. It may consist chiefly of the fermented urine of horses, or cows, or pigs, or a mixture of them all; or it may be produced by converting the *solid and liquid* excrementitious matters of our domestic animals into a muddy liquid; and in this process of liquefying the solid excrements and preparing them for distribution on the land, much or little water may be used. These and several other circumstances must, of course, affect the composition of liquid manure, and with it its fertilising value.

In order, therefore, to ascertain how far the observed dissimilarity in the practical effects of liquid manure depends on differences in composition, I procured six samples of liquid manure, namely:—

1. From Westonbirt, near Tetbury, Gloucestershire.
2. From Badminton.
3. From Royal Agricultural College farm; collected 1857.
4. From ditto, collected 1858.
5. From Tiptree Hall, Essex; clear liquid.
6. From ditto; muddy liquid.

A strong, disagreeable smell, and more or less dark colour, were common to all; but the differences in the concentration of the liquids were much greater than I expected.

No. 1.—*Liquid Manure from Westonbirt, near Tetbury.*

A large jar filled with liquid manure from Westonbirt farm, the property of Stainer S. Holford, Esq., was kindly furnished me by Mr. Rich, Mr. Holford's agent. The tank from which the liquid was taken had been recently erected, and no expense appears to have been spared in making it perfectly water-tight. A perfectly well-fitting cover sheltered the contents against rain, and against evaporation in hot and dry weather. The contents of the tank consisted chiefly of the drainings of the stables, and contained comparatively little cows' or pigs' urine. On setting the liquid-manure pump in motion hardly any liquid made its appearance, but in its stead a thick white froth continued to flow off for some minutes; after which a dark greenish-brown, very offensive and pungent-smelling liquid was pumped up. On agitating this liquid it became very frothy, and at the same time gave off a strong and pungent smell. The froth and pungent smell no doubt were due to the evolution of carbonate of ammonia.

At 62° Fahr. the liquid manure from Westonbirt had a specific gravity of 1·006.

Evaporated to dryness an imperial pint (7000 grs.) furnished 41·8025 grs. of solid residue (dried at 212°).

On burning in a platinum dish this amount of solid matter left 26·281 of ash. A separate portion of dry residue was used for the determination of the amount of nitrogen present in the shape of non-volatile ammoniacal salts and nitrogenized organic matters.

A fresh quantity of liquid manure (7000 grs.) was next neutralized with dilute hydrochloric acid, and thereby the volatile carbonate of ammonia was fixed, and obtained on evaporation to dryness on the water-bath as sal ammoniac. The addition of hydrochloric acid had also the effect of decomposing humate and ulmate of ammonia, both of which occur in liquid manure, and impart to it a more or less dark colour. The organic acids separate in the form of a brownish flaky substance, whilst the ammonia unites with the hydrochloric acid, forming with it sal ammoniac. Liquid manure, on boiling, yields ammonia, even if it contains no free nor volatile carbonate of ammonia. This evolution of ammonia arises from the decomposition of ulmate or humate of ammonia—two compounds which, on boiling with bicarbonate of potash, a constituent that is always present in liquid manure, yield free ammonia.

The dry residue obtained by evaporating 7000 grains of liquid manure, with the addition of hydrochloric acid, was employed for determining the whole amount of nitrogen present in the shape of nitrogenized matters, as well as non-volatile and volatile

salts of ammonia. By deducting the amount of nitrogen found in the residue obtained on evaporation without acid from the residue obtained with acid, and calculating the remainder as ammonia, the proportion of ammonia existing as carbonate and as humate and ulmate of ammonia was ascertained.

The mineral portion left on burning the residue was carefully analysed according to the best and most recent methods, which need not be mentioned here in detail.

According to the several results obtained in the analysis, an imperial gallon of liquid manure from Westonbirt, Tetbury, Gloucestershire, contained:—

Ammonia driven out on boiling (chiefly in the shape of volatile carbonate and some as humate and ulmate of ammonia)		108·36
* Organic matters and non-volatile ammoniacal salts		155·44
Mineral matters (ash)	262·81	
Consisting of—		
Soluble silica		2·49
Oxide of iron		·70
Lime		5·34
Magnesia		2·96
Potash		103·23
Chloride of potassium		72·00
Chloride of sodium		17·18
Phosphoric acid		2·70
Sulphuric acid		22·31
Carbonic acid and loss		33·90
Total		526·61

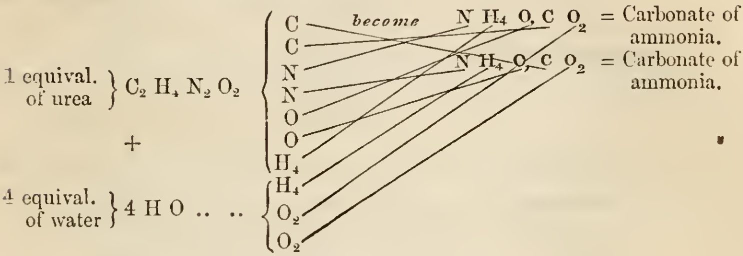
* Containing 4·78 grains of nitrogen.

An imperial gallon of this liquid thus contains:—

Total amount of mineral matters	262·81
,, non-volatile combustible matters	155·44
,, nitrogen	94·02
Which is equal to ammonia	114·16

It will be seen that the proportion of ammonia in this description of liquid manure is very considerable. It is indeed very much greater than in any other kind which I have examined. We may therefore expect that it will produce a powerful effect, more especially upon grass-land. But as carbonate of ammonia is a caustic agent, and acts too energetically when applied to a standing crop in a liquid so rich in ammonia as the tank liquid from Westonbirt, a considerable quantity of water— say three times the bulk of water—should be added before the liquid can be applied with safety. It will likewise be noticed that nearly the whole of the nitrogen which originally existed in the urine of horses in the state of urea had been

changed into carbonate of ammonia. This change of urea in a liquid containing a variety of other organic matters proceeds with extreme rapidity. Urea, an organic compound consisting of two equivalents of carbon, two of oxygen, two of nitrogen, and four of hydrogen, has only to take up the elements of four equivalents of water in order to become converted into two equivalents of carbonate of ammonia. This change will at once become intelligible by glancing at the following diagrammatic representation:—



As carbonate of ammonia is volatile, and escapes gradually even from dilute liquids, it is desirable to fix it at once. This can be done most effectually and with little trouble by throwing into the tank from time to time a Winchester quart of brown sulphuric acid. This acid, uniting with the ammonia, drives out the carbonic acid of the carbonate, which causes a more or less extreme effervescence, and changes the volatile carbonate into non-volatile sulphate of ammonia—a salt which is far less caustic than carbonate of ammonia, and more valuable than the latter as a fertilising agent.

The inorganic portion of the liquid manure from Westonbirt consists principally of alkaline salts. The proportion of potash in these salts is very considerable. Most of the potash mentioned in the above analysis occurs in the state of bicarbonate of potash; there is also a good deal of chloride of potassium and some sulphate of potash. Phosphoric acid, on the other hand, exists only sparingly in this, and, I may add, in most other kinds of liquid manure; and as this acid is so essential for the healthy growth of all cultivated crops, we can readily understand that liquid manure, however valuable it may be in other respects, on account of the great deficiency of phosphoric acid and the preponderance of ammonia, when applied by itself to grass-land produces an over-luxuriant and rank herbage, and when applied to a white crop produces corn more remarkable for long, coarse, and abundant straw than for fine and plentiful grain.

Liquid manure, when produced exclusively from the liquid excrements of horses, cattle, or pigs, cannot, on account of this

deficiency of phosphoric acid, be regarded as a perfect manure, and should not be used alone, but always in conjunction with manures rich in phosphoric acid, such as bone-dust or superphosphate.

In the following Table I have calculated the percentage composition of the solid matters that remain behind on evaporation, and also the percentage composition of the mineral portion or ash:—

	Per cent. Composition of Solid Substances in Liquid Manure.	Per cent. Composition of Ash of Liquid Manure.
* Organic matters	37·16	
† Inorganic matters (ash)	62·84	
	100·00	
* Containing nitrogen	1·14	
† Consisting of—		
Soluble silica	·59	·95
Oxide of iron	·16	·27
Lime	1·28	2·04
Magnesia	·70	1·13
Potash	24·82	39·51
Chloride of sodium	4·10	6·54
Chloride of potassium	17·21	27·40
Phosphoric acid	·64	1·03
Sulphuric acid	5·33	8·49
Carbonic acid	8·01	12·64
	62·84	100·00

2.—*Liquid Manure from Badminton.*

Mr. Thompson, agent to his Grace the Duke of Beaufort, kindly supplied me with a specimen of liquid manure, which had been kept for several years in the tank. It was much darker coloured than the liquid from Westonbirt, and contained a larger amount of organic matter in solution than any of the other varieties of liquid manure which I examined. It was nearly neutral to test-paper, but on boiling gave off a strong smell of ammonia. Its smell was not so offensive as the liquid from Westonbirt.

The Badminton liquid was composed chiefly of the drainings of cattle-sheds and yards. Its examination appeared to me desirable for the sake of comparison with the preceding sample, which was principally composed of horse-urine.

On evaporation to dryness on the waterbath, 7000 grains furnished 60 112 grains of solid residue dried at 212° Fahr. This quantity on burning gave 36·190 grains of mineral matter or ash.

On analysing the ash it was found to contain in 100 parts of—

Soluble silica	2·76
Oxide of iron	·19
Lime	6·96
Magnesia	4·24
Potash	31·02
Chloride of potassium	21·55
Chloride of sodium	12·72
Phosphoric acid	2·63
Sulphuric acid	10·39
Carbonic acid and loss	7·54
	100·00

The residue left on evaporation of 7000 grains of liquid manure, burnt with soda-lime, was found to contain ·898 grains of nitrogen.

Another 7000 grains of the same liquid, evaporated with hydrochloric acid, gave a residue which, burnt with soda-lime, yielded 1·838 of nitrogen.

The solid matter left on evaporation consequently contained :—

Organic matters		39·79
Containing 1·49 of nitrogen.		
Mineral matters	60·21	
Consisting of—		
Soluble silica		1·66
Oxide of iron		·11
Lime		4·19
Magnesia		2·55
Potash		18·67
Chloride of potassium		12·97
Chloride of sodium		7·65
Phosphoric acid		1·58
Sulphuric acid		6·20
Carbonic acid and loss		4·63
		100·00

The specific gravity of the liquid at 62° Fahr. was 1·007. According to these determinations a gallon of liquid manure from Badminton contained :—

Ammonia (chiefly as ulmate and humate of ammonia)		11·41
* Organic matters		239·22
* Containing 8·98 of nitrogen. Which is equal to 10·90 of ammonia.		
Inorganic matters (ash)	361·90	
Consisting of—		
Soluble silica		9·98
Oxide of iron		·68
Lime		25·18
Magnesia		15·33
Potash		112·26
Chloride of sodium		46·03

Chloride

Chloride of potassium	77·38
Phosphoric acid	9·51
Sulphuric acid	37·60
Carbonic acid	27·95
	612·53

On comparing the composition of the two samples from Westonbirt and Badminton, it will be found that the latter contains both more organic and mineral matters in solution. Notwithstanding the larger amount of organic matter, it contains very much less ammonia. A somewhat smaller proportion of ammonia might have been expected, since cows' urine, which entered largely into its composition, is much poorer in nitrogen than horse-urine, which chiefly composed the liquid manure from Westonbirt. However, the quantity of ammonia (only 11·41 in a gallon) is so inconsiderable that the differences in the proportion of the original liquids which chiefly composed these two kinds of liquid manure are altogether insufficient to account for the small quantity of free ammonia in that from Badminton. This liquid, having been kept in an open tank for more than three years, has evidently lost by evaporation carbonate of ammonia, which we have seen is rapidly formed during the decomposition of urea. That this really was the case was proved by the small quantity of carbonate of ammonia which was left in it. During the long time it was kept in the tank the volatile carbonate of ammonia had every chance of escaping. We may thus learn that it is not advisable to preserve liquid manure for a long period, and that the safest plan is to fix the ammonia at once by the addition of some sulphuric acid.

The organic matters left on evaporation of both kinds of liquid manure presented the same characters, and both contained an identical percentage of nitrogen. Thus 155·44 grains of organic matters contained in that from Westonbirt yielded on analysis 4·78 grains of nitrogen, whilst 239·32 grains of organic matters found in the Badminton liquid furnished 8·98 grains. This gives for 100 parts 3·75 grains of nitrogen for each of the two samples. No appreciable difference is observable in the composition of the mineral portion. The ash of the Westonbirt manure, like that of the Badminton liquid, is rich in salts of potash and is greatly deficient in phosphoric acid.

3.—*Liquid Manure from the Royal Agricultural College Farm, Cirencester. Collected in* 1857.

The liquid-manure tank on the College Farm is placed close to the manure-pit, in which stable manure, cows' and pigs' dung are collected together. It is of a sufficient capacity to hold, in

addition to the drainings from the manure-pit and stables, the sewerage from the College. Animal refuse matters, such as the blood of animals killed on the farm, the carcases of dead sheep, lambs, &c., are thrown into the liquid manure-tank; and by these additions no doubt the fertilising properties of this kind of liquid manure are greatly increased.

The smell of this liquid, especially in summer, is very bad; the decomposition of the animal matters proceeds more rapidly in hot weather, and in a dry season like the last the smell of sulphuretted hydrogen is so strong that, except on a rainy day, the liquid cannot be pumped over the manure-heap without creating a nuisance.

The soil on all the fields of the College farm contains a good deal of clay; and, though many fields are called light, the soil is only light in virtue of the limestone and gravel that abound in those places. Separated from the stones, the soil from these so-called light fields is quite stiff and heavy, since it contains hardly any sand, and is composed chiefly of clay and lime.

We have applied our tank-liquid by itself on various occasions, but have never seen much good produced by it. The soils on the College farm and neighbourhood derive, I believe, little or no benefit from liquid manure. In a subsequent page I shall state the reasons why land like this is not benefited by it. On account of the inefficacy of this liquid when applied by itself on our farm, and the expense of distributing it, the liquid manure is now rarely used by itself, but is pumped when required over the manure-heap.

Abundance of straw being produced on the farm, which in some way or other has to be converted into manure, the dung in the pit is generally drier than it is desirable it should be, and affords an excellent opportunity for the absorption of the tank-liquid.

Seven thousand grains of tank-liquid collected in 1857 gave on evaporation to dryness 12·110 grains of solid matter, which furnished on burning 7·394 grains of mineral matters.

The mineral matters were found to contain in 100 parts:—

Silica	1·56
Lime	17·59
Magnesia	2·24
Chloride of sodium	23·34
Chloride of potassium	10·43
Potash	18·14
Phosphoric acid	3·12
Sulphuric acid	4·62
Carbonic acid	18·96
	100·00

Seven thousand grains evaporated to dryness with the addition of hydrochloric acid gave a residue that produced on burning with soda-lime 2·296 grains of ammonia.

The residue from another 7000 grains evaporated without acid only yielded ·303 of nitrogen.

The following is the composition of the solid substances in this sample of liquid manure:—

Organic matters	38·94
Containing 2·504 of nitrogen.	
Which is equal to 3·040 of ammonia.	
* Inorganic matters (ash)	61·06
	100·00

* Consisting of—	
Silica	·95
Lime	10·75
Magnesia	1 37
Chloride of sodium	14·25
Chloride of potassium	6·36
Potash	11·08
Phosphoric acid	1·91
Sulphuric acid	2·81
Carbonic acid and loss	11·58

According to these analytical data the liquid manure drawn in 1857 from the tank on the College farm, Cirencester, had the following composition:—

An imperial gallon contained:—

Water and volatile ammoniacal compounds ..	69878·900
Solid residue (dried at 212°) matter	121·100
	70000·000

A gallon contained:—

Ammonia (volatilized on heating, and present chiefly as carbonate and humate of ammonia		22·964
Organic matters		47·157
Containing 3·033 of nitrogen.		
Equal to 3·683 of ammonia.		
Mineral matters (ash)	73·943	
Consisting of—		
Silica		1·154
Lime		13·011
Magnesia		1·660
Potash		13·411
Chloride of potassium		7·712
Chloride of sodium		17·258
Phoshoric acid		2·304
Sulphuric acid		3·408
Carbonic acid and loss		14·025
		144·064

There is a very marked difference in the composition of this

liquid and that from Badminton or Westonbirt. In the first place, it will be noticed that the proportion of solid matter in the Cirencester liquid is very much smaller than in the other two. In that from Badminton we have almost exactly 5 times as much solid matter as in that from Cirencester, and in that from Westonbirt about $3\frac{1}{2}$ times as much.

In the next place, it will strike any one who carefully compares these analytical results that, notwithstanding the much larger proportion of water in the Cirencester liquid, it contained more than double the amount of ammonia which was found in the sample from Badminton.

Thus the proportion of ammonia which is driven out on boiling amounts in the Badminton liquid to only 11·41 grains per imperial gallon, whilst in that from Cirencester there are 22·964 grains of such ammonia per gallon.

I have observed already that the Badminton liquid has evidently lost ammonia by long keeping; while injurious evaporation of this kind does not appear to have deteriorated the contents of the Cirencester tank. Again, it will be seen that even the total amount of nitrogen is somewhat larger in the Cirencester than in the Badminton sample. In the former we have 18·911 grains of nitrogen, equal to 22·964 of ammonia, present in the state of volatile compounds of ammonia, and 3·033 of nitrogen, equal to 3·683 of ammonia, present in the state of nitrogenised organic matters and fixed salts of ammonia, or together 21·944 per cent. of nitrogen, corresponding to 26·647 of ammonia; whilst in the latter we have only 9·40 grains of nitrogen in the state of volatile compounds of ammonia, corresponding to 11·41 grains of ammonia, and 8·98 grains of nitrogen, in the shape of nitrogenised organic matters and fixed ammoniacal salts, or together 18·38 of nitrogen, which is equal to 22·31 grains of ammonia.

The composition of the ash of the Cirencester liquid manure also offers some points of interest, which, however, I shall consider after having given some particulars respecting the characters of the contents of our tank in 1858.

4.—*Liquid Manure from Royal Agricultural College Farm, Cirencester. Collected in* 1858.

I was anxious to ascertain whether or not the contents of our tank varied much at different periods, and for this purpose pumped up a quantity of liquid sufficient for examination in 1858.

The physical characters of the tank-liquid were the same as in 1857. It was allowed to subside for some days, and was perfectly clear when submitted to analysis.

Specific gravity of liquid manure at 62° Fahr. = 1·0014. 7000 grains evaporated to dryness gave 11·186 grains of dry residue, and this reduced to ashes in a platinum capsule gave 9·127 grains of ash.

We have thus in one imperial gallon:—

	Grains.
Water and volatile compounds	69,888·14
Organic matters	20·59
Mineral matters	91·27
	70,000·00

Evaporated to dryness with hydrochloric acid a residue was obtained which yielded on combustion with soda-lime 30·80 grains of nitrogen calculated per gallon. The residue obtained by evaporation without acid gave 1·49 grains of nitrogen per gallon.

The ash of this liquid manure contained in 100 parts:—

Soluble silica	2·57
Lime	12·58
Magnesia	3·15
Potash	18·54
Chloride of potassium	3·01
Chloride of sodium	44·21
Phosphoric acid	5·30
Sulphuric acid	4·32
Carbonic acid and loss	6·32
	100·00

An unexpectedly large amount of chloride of sodium having been found in this analysis, and rather less potash than I expected, I caused fresh determinations of chlorine and the alkalies to be made. In the first chlorine determination I obtained 28·27 per cent. of chlorine in the ash; in the second 27·90 per cent. The second determinations of potash and soda likewise yielded satisfactory results, for I obtained 18·63 of potash, 1·51 of chloride of potassium, and 44·81 of chloride of sodium; thus proving that the ash of this liquid manure really contained the amount of chloride of sodium and potash which is given in the above analysis.

The following numbers express the per cent. composition of the solid matters:—

* Organic matter	18·40
Inorganic matter	81·60
	100 00
* Containing nitrogen	1·33
Consisting of—	
Soluble silica	2·09
Lime	10·26

Magnesia	2·57
Potash	15·06
Chloride of sodium	36·07
Chloride of potassium	2·45
Phosphoric acid	4·32
Sulphuric acid	3·52
Carbonic acid	5·26

Calculating the preceding results per imperial gallon, we have in the tank-liquid from the College farm, Cirencester, collected in 1858, the following proportions of the various constituents :—

Ammonia (in the state of carbonate and humate)		35·58
Organic matters		20·59
Containing 1·49 of nitrogen. Equal to 1·81 of ammonia.		
Inorganic matters (ash)	91·27	
Consisting of—		
Soluble silica		2·34
Lime		11·48
Magnesia		2·87
Potash		16·92
Chloride of potassium		2·74
Chloride of sodium		40·35
Phosphoric acid		4·83
Sulphuric acid		3·94
Carbonic acid and loss		5·80
		147·44

A comparison of the liquid manure from Cirencester with the preceding kinds examined will show that there is a great deal more solid matter contained in solution in the samples from Westonbirt and Badminton ; that there is more ammonia in that from Westonbirt than in that from Cirencester, but that the latter contains more ammonia than the Badminton manure.

It will also be observed that chloride of sodium enters more largely into the composition of the liquid from the College farm, and also that it contains more phosphoric acid and less potash than the preceding liquids.

Comparing the composition of the Cirencester sample collected in 1857 with that collected in 1858, it will be seen that in 1858 this tank-liquid contained less than half the quantity of organic matters that were found in it in 1857, but that in 1858 it was somewhat richer in ammonia.

On the other hand, the proportion of mineral matters in 1858 was larger than in 1857, and the percentage of phosphoric acid and chloride of sodium in the mineral portion of the liquid

collected in 1858 was more considerable than in the ash of the liquid collected in 1857.

At different periods the liquid manure obtained on the same farm thus exhibited marked differences in composition, which differences cannot fail to influence the effects which it is capable of producing in the field.

The large proportion of salt in the liquid collected in 1858 I am inclined to think owes its origin to a heap of refuse salt which had been purchased at a very cheap rate. In all probability, some of this salt had, by some means or other, found its way into the tank.

5.—*Liquid Manure from Tiptree Hall, Essex.*

I am indebted to Mr. Mechi for kindly supplying me with the material of which the subjoined two analyses were made. Mr. Mechi keeps the greater part of his stock on boards, and collects the solid and liquid excrements together in a large tank. Before distributing the contents by means of steam-power and underground pipes it is much diluted with water.

The tank-liquid from Tiptree Hall possessed a strong smell and had a dark muddy appearance. A portion of the well-shaken liquid was allowed to subside, and the clear portion examined separately. This clear liquid had a light yellowish colour, and gave a very faint ammoniacal reaction with red litmus paper.

An imperial gallon gave on evaporation to dryness 29·19 grains of fixed residue dried at 212° Fahr.

On burning, this residue left 21·49 grains of ash.

A gallon thus contained :—

Water and volatile matters ..	69,970·81	
Organic matters	7·70	29·19 fixed residue.
Inorganic matters	21·49	
	70,000·00	

The inorganic portion, on analysis, was found to consist in 100 parts of—

Soluble silica	7·84
Insoluble silicious matter (fine clay)	3·54
Lime	20·62
Magnesia	8·31
Potash	6·11
Chloride of potassium	5·16
Chloride of sodium	25·45
Phosphoric acid	11·01
Sulphuric acid	10·02
Carbonic acid	1·94
	100·00

In the preparation of the ash the greater part of the lime, which exists in the original liquid as bi-carbonate, was burned caustic; hence the small proportion of carbonic acid which was found on analysis.

The mineral portion of this liquid resembles in its general characters that of the preceding ones. But the relative proportions of the several constituents differ considerably from those of the liquid manures from Badminton, Westonbirt, and Cirencester.

It is chiefly by a much larger percentage of lime and phosphoric acid that the Tiptree Hall sample is distinguished from the others. Being prepared from solid as well as liquid excrements, the larger amount of phosphoric acid finds a ready explanation, as it occurs abundantly in the solid excrements of animals, whilst it is absent in their urine.

During the fermentation of the solid excrementitious matters, insoluble combinations of phosphoric acid are rendered soluble and made available for the immediate use of plants.

On account of the more abundant occurrence of phosphoric acid in this species of liquid manure, it is a fertiliser which is better adapted for general manuring purposes than the liquids previously examined. The solid residue left, on evaporating to dryness an imperial gallon of liquid, gave on burning with soda-lime ·52 grains of nitrogen, equal to ·63 of ammonia.

Evaporated with the addition of hydrochloric acid, the same quantity of liquid yielded on combustion with soda-lime 3·29 grains of nitrogen, which is equal to 3·99 of ammonia.

The following analysis expresses the percentage composition of the solid matter contained in this liquid:—

* Organic matters	26·38
† Inorganic matters	73·62
	100·00
* Containing nitrogen	1·78
Equal to ammonia	2·16
† Consisting of—	
Soluble silica	5·77
Insoluble silicious matter (fine clay)	2·60
Lime	15·18
Magnesia	6·11
Potash	4·49
Chloride of potassium	3·79
Chloride of sodium	18·73
Phosphoric acid	8·10
Sulphuric acid	7·37
Carbonic acid	1·48

These analytical data lead to the following composition:—

Composition of Clear Liquid Manure from Tiptree Hall Farm.

* Water and ammonia driven out on boiling		69,970·81
† Organic matters		7·70
Mineral substances	21·49	
Consisting of—		
Soluble silica		1·68
Insoluble silicious matter (fine clay)		·76
Lime		4·43
Magnesia		1·78
Potash		1·31
Chloride of potassium		1·10
Chloride of sodium		5·46
Phosphoric acid		2·36
Sulphuric acid		2·15
Carbonic acid and loss		·45
		70,000·00

* Containing ammonia	3·36
† Containing nitrogen	·52
Equal to ammonia	·63
Total quantity of nitrogen per gallon	3·29
Equal to ammonia	3·99

I have also determined the specific gravity of this liquid, and found it to be at 62° Fahr. = 1·0006, or scarcely differing in specific gravity from that of pure water.

The small amount of fertilising matter in the clear tank-liquid from Tiptree Hall renders it probable that little benefit will result from its application except in very large and repeated doses. There are many drinking waters in daily use which contain more solid substances in solution than Mr. Mechi's tank-liquid. Thus, for instance, Cirencester pump-water contains between 40 and 48 grains of solid matters in the imperial gallon; and in a well situated in a badly-drained part of Cirencester I have lately found as much as 97·54 grains of solid matters in the gallon, or more than three times the amount present in Mr. Mechi's clear liquid manure. There is, however, a marked difference between ordinary waters and the tank-liquid from Tiptree Hall: the former, even when contaminated, like the Cirencester water, with the sewage of towns, contain but little organic matter and mere traces of ammonia, whilst the latter held in solution a good deal of organic matter as well as salts of ammonia.

Small as the intrinsic fertilising value of the liquid manure from Tiptree Hall is, Mr. Mechi yet informs us that it produces a marvellous effect on his farm. This would seem to indicate that, if the improvement in the productive powers of Mr. Mechi's land is really to be attributed to the application of liquid manure, a very small quantity of fertilising matters, distributed uniformly in a state in which they can be absorbed at once by

the roots of plants, is capable of producing a more striking effect than probably six times the amount of fertilising matters applied to the land in a less favourable condition.

The proportion of ammonia in Mr. Mechi's liquid manure, in comparison with that existing in cultivated soils, is quite insignificant. If, therefore, the land on Tiptree farm is indeed so much improved by irrigation with liquid manure, the question naturally arises in one's mind whether ordinary irrigation with common spring water might not produce equally good results.

6.—*Liquid Manure from Tiptree Hall; muddy liquid.*

The specific gravity of the muddy liquid was found to be 1·001 at 62° Fahr., or only a little higher than the clear liquid, and much lower than the specific gravity of the other varieties of liquid manure which I examined.

Before analysation, the muddy liquid was well shaken, in order to distribute uniformly the suspended and dark-coloured matters. These consisted partly of organic matters, partly of fine clay.

On evaporation, an imperial gallon of the muddy liquid gave 95·76 grains of solid residue, dried at 212° Fahr. This quantity, on burning, left 45·57 of ash, which on analysis yielded the following results :—

Soluble silica (soluble in dilute potash solution) ..	14·20
Insoluble silicious matter (fine clay)	33·30
Oxides of iron and alumina	5·18
Lime	14·50
Magnesia	3·80
Potash	·77
Chloride of potassium	4·28
Chloride of sodium	10·56
Phosphoric acid	8·17
Sulphuric acid	4·26
Carbonic acid and loss	·98
	100·00

The residue left on evaporation of 1 gallon of muddy liquid yielded 2·17 of nitrogen, which is equal to 2·63 grains of ammonia.

Evaporated with the addition of hydrochloric acid, an imperial gallon left a residue which on burning with soda-lime produced 4·51 grains of nitrogen, equal to 5·476 of ammonia.

One hundred parts of dry matters contained in the muddy liquid from Tiptree Hall contained :—

* Organic matters	52·41
† Mineral substances	47·59
	100·00

* Containing nitrogen	2·27
Equal to ammonia	2·75

† Consisting of—

Soluble

Soluble silica (soluble in caustic potash)	6·75
Insoluble silicious matter (fine clay)	15·84
Oxides of iron and alumina	2·46
Lime	6·90
Magnesia	·81
Potash	·36
Chloride of potassium	2·03
Chloride of sodium	5·02
Phosphoric acid	3 88
Sulphuric acid	2·02
Carbonic acid and loss	·52

According to these analytical results, an imperial gallon of the muddy liquid manure from Tiptree Hall contained :—

* Water and ammonia driven out on boiling		69,904·24
† Organic matters		50·19
Mineral matters	45·57	
Consisting of—		
Soluble silica	6·47	
Insoluble silicious matter (clay)	15·17	
Oxides of iron and alumina	2·36	
Lime	6·60	
Magnesia	1·73	
Potash	·35	
Chloride of potassium	1·95	
Chloride of sodium	4·81	
Phosphoric acid	3·72	
Sulphuric acid	1.94	
Carbonic acid and loss	·47	
		70,000·00
* Containing ammonia		2·846
† Containing nitrogen		2·17
Equal to ammonia		2.63
Total quantity of nitrogen per gallon		4·51
Equal to ammonia		5·476

It will be seen that the proportion of organic matter, as well as that of mineral matters, in the muddy liquid is much larger than in the clear liquid. But even this additional quantity of fertilising substances does not materially increase its value, for the additional amount of organic matters furnishes only 1·65 grains of nitrogen beyond the nitrogen contained in the organic substances of the clear liquid; and the additional mineral matters chiefly consist of fine clay, which of course adds nothing to the fertilising value of this manure.

Since the intrinsic value of all manuring substances is mainly dependent upon the amount of nitrogen, phosphoric acid, and potash which they contain, some idea of the relative merits of these six kinds of liquid manure may be formed by comparing the proportions of these constituents which each kind contains. I have, therefore, grouped together these determinations of nitrogen, potash, and phosphoric acid, as well as some other data which will facilitate comparison.

In the first place, I would observe that five of the liquid manures possessed the following specific gravities at 62° Fahr.:—

Liquid manure from	Westonbirt	1·006
,,	Badminton	1·007
,,	College Farm, 1858	1·0014
,,	Tiptree Hall, clear liquid ..	1·0006
,,	Tiptree Hall, with sediment	1·001

The specific gravity of these five liquids corresponds with the amount of solid matters which each kind contains in solution. To a certain extent the specific gravity of different kinds of liquid manure may serve as an indication of their relative fertilising value.

Proportion of dry Organic and Inorganic Matters in 1 *Gallon of*—

——	Organic Matters.	Mineral Matters.	Total.
Liquid manure from Westonbirt	155·44	262·81	418·25
,, Badminton	239·22	361·90	601·12
,, College Farm, 1857 ..	47·157	73·943	121·10
,, College Farm, 1858 ..	20·59	91·27	111·86
,, Tiptree, clear liquid ..	7·70	21·49	29·19
,, Tiptree, with sediment	50·19	45·57	95·76

The difference in the amount of solid matters contained in liquid manure are much greater than I expected to find them, and, curiously enough, the liquid manure from Tiptree Hall, which I anticipated would be very concentrated, was by far the weakest of all; the clear liquid contained in reality not more than one-twentieth part of the amount of solid fertilising substances which I found in the Badminton manure, and between one-fourth and one-fifth of the amount contained in the Cirencester tank-liquid, which I always considered very poor stuff, though it smelt extremely disagreeable.

In the next place I shall group together—

The Proportion of Nitrogen, ready-formed Ammonia, and total Nitrogen in 1 *Gallon of*—

——	Nitrogen in Organic Matters.	Nitrogen as Ammonia.	Total Nitrogen.	Equal to Ammonia.
Liquid manure from Westonbirt	4·78	89·24	94·02	114·16
,, Badminton	8·98	9·40	18·38	22·32
,, Cirencester, 1857 ..	3·033	18·911	21·944	26·647
,, Cirencester, 1858 ..	1·49	29·31	30·80	37·39
,, Tiptree, clear liquid	·52	2·77	3·29	3·99
,, Tiptree, muddy liquid	2·17	2·34	4·51	5·476

In the Government Report by Mr. Austin, C.E., on the Means of Deodorising and Utilising the Sewage of Towns, published in

1857, the author gives a short account of a visit to Mr. Mechi's farm, and, amongst other particulars referring to the working expenses for distributing liquid manure at Tiptree, states on page 57 :—

"The quantity delivered daily in ten working hours would be 130 tons of water; but Mr. Mechi estimates that the cost of delivery may be fairly placed at from 1½*d.* to 2*d.* per ton, the specific gravity of liquid manure being so much greater than water.

"There will be distributed over the whole farm on the average from 45,000 to 50,000 gallons of liquid manure per acre per annum."

Assuming the composition of the liquid manure not to vary materially at different periods, 50,000 gallons of liquid manure, with the sediment, would yield $50{,}000 \times 5{\cdot}476$ grains, or 273,800 grains of ammonia, or in round numbers 39 lbs. of ammonia.

Peruvian guano yields from 16 to 18 per cent. of ammonia. To produce the above-mentioned 39 lbs. of ammonia, we should require 2 cwt. of Peruvian guano of the best quality. At 13*l.* per ton, the 2 cwt. would cost 26*s.* For this outlay of money the same amount of ammonia would be obtained which is yielded by 50,000 gallons of Mr. Mechi's muddy tank-liquid.

Deducting the clay and earth which swell the amount of solid matter in the muddy tank-liquid, and taking no account of the suspended organic matter, which may be done with propriety, since account has been taken of the nitrogen, the only valuable portion in it, we have as nearly as possible the same weight of solid matter in 2 cwt. of Peruvian guano which is contained in 50,000 gallons of the Tiptree liquid manure. But the solid constituents of Peruvian guano being more valuable than those in the liquid, a balance would be left in favour of guano. Allowing 4*s.* for sowing 2 cwt. of guano, 30*s.* would cover the cost price and expense of applying the guano.

If 1 ton of liquid manure, according to Mr. Mechi's estimate, costs for delivery 2*d.*, 50,000 gallons, = 500,000 lbs., will cost 1*l.* 17*s.* 2*d.*

The fertilising matters in 50,000 gallons of liquid manure thus will cost for delivery 7*s.* 2*d.* more than the price of the materials and expenses of application would amount to were they put upon the land in the shape of Peruvian guano. Whether or not it is good economy to spend 1*l.* 17*s.* 2*d.* for the delivery of fertilising materials which are intrinsically worth about 26*s.*, or at the most 30*s.*, is a question which may be safely left in the hands of practical men. It is a question which, I think, cannot be answered in a general way. On some soils I believe even a larger expense for delivery may be incurred, whilst on others less than a quarter the expense may be ruinous.

Many persons, deceived by the bad smell and dark colour of

liquid manure, entertain very extravagant notions respecting the amount and intrinsic value of the fertilising matters which it contains. Such notions are a great bar to the fair adjustment of the question so frequently asked—Will liquid manure pay or not? It is well, therefore, to remember that 50,000 gallons may not contain more fertilising matter than 2 cwt. of good Peruvian guano; and that this opinion is based on analytical facts which are quite independent of any theoretical reasonings.

In the following Table I have placed side by side the—

Amount of Phosphoric Acid, Potash, and Chloride of Potassium, expressed in Grains and Fractions of Grains, in 1 Imperial Gallon of—

——	Phosphoric Acid.	Potash and Chloride of Potassium together.
Liquid manure from Westonbirt	2·70	175·23
,, Badminton	9·51	189·64
,, Cirencester College, 1857 ..	2·304	21·123
,, Cirencester College, 1858 ..	4·83	19·66
,, Tiptree, clear liquid	2·36	2·41
,, Tiptree, with sediment	3·72	2·30

Even a superficial reader will be struck with the great variations which are exhibited in any of the Tables in which is contrasted for convenience of comparison the relative amount of the more important fertilising substances contained in a gallon of liquid manure. It is evident that the practical effects which it is capable of producing depend upon the nature and amount of fertilising matters which enter into its composition; and as the composition of the different kinds differs so very widely, we cannot feel surprised to hear that in one instance it has done marvels, and in others little or no good. However, there are other circumstances besides the difference in composition which must be taken into account if we wish to entertain correct ideas respecting the utility of liquid manure. I shall therefore consider in the next chapter the character of the soils upon which it is applied with decided advantage.

II. On the Character of Soils upon which Liquid Manure is applied with manifest Benefit, and on the Reasons of Success.

Experience has shown that liquid manure produces the most beneficial and most striking effects when applied to light, deep, sandy soils, resting upon a porous subsoil. However poor originally such a soil may be, after repeated applications of liquid manure it is rendered capable of yielding remunerative

and even large crops. Witness, for instance, the almost sterile sands which abound in Flanders, and the astonishing change which it effects upon them.

Provided the subsoil be well drained or of a porous nature, it may be safely asserted that *any* sandy soil, however sterile in its natural state, may be made to yield heavy crops through the instrumentality of liquid manure. Indeed the poorer the soil the more striking would be the result.

For poor, sandy soils, the system of liquid manuring cannot be too highly recommended, for I believe that all other plans of applying fertilizing materials to them will be found far less efficacious in their results. If we examine into the chemical and physical characters of soils similar to those which abound in Flanders, we shall not be long in discovering the causes of the astonishing success which has crowned the system of liquid manuring in Belgium and other countries.

In order to render more intelligible the explanation of the causes of the highly beneficial effects which liquid manure produces under these circumstances, I may be allowed to introduce here the composition of two sandy soils which I have lately examined.

Composition of Two Sandy Soils from the neighbourhood of Cirencester.

	No. I.	No. II.
Organic matter and a little water of combination	5·36	4·82
Oxide of iron and alumina	5·78	12·16
Carbonate of lime	·25	·15
Potash, soda, and magnesia	·49	·46
Phosphoric acid	none.	faint trace.
Sulphuric acid	trace.	trace.
Chlorine	trace.	trace.
Insoluble silicious matter (chiefly fine quartz sand with but little clay)	88·12	82·41
	100·00	100·00

It will be observed that both soils abound in quartz-sand and are deficient in clay and lime. No. I. especially is very sandy, and even poorer than No. II., for I could not detect in it any phosphoric acid, and found in it less clay than in No. II.

On land of that description, corn, roots, or grass cannot possibly be grown with advantage without manure, for in these soils all the more important mineral constituents which are required for sustaining a healthy and luxuriant vegetation, are either altogether absent, or are greatly deficient. Thus No. I. contains no appreciable quantity of phosphoric acid, and No. II. mere traces. Again, it will be noticed that lime, which in smaller or larger quantities is contained in every kind of agricultural produce, occurs very sparingly in these soils, and that the per-

centage of potash and soda in both is far from what it ought to be in order to meet the wants of growing plants. Taking potash, soda, and magnesia together, there is not quite a half per cent. in these soils, and probably the major part of this fractional percentage consists of magnesia. Sulphuric acid likewise is wanting in both soils. In short, both are poor soils that require to be heavily manured before they can be made to yield a respectable crop, and that soon return to their natural sterile state when the usual dressings of manure are withheld.

Hungry soils of such and similar composition are grateful for almost any kind of manure, for, as they are greatly deficient in plant-food, manures that contain even small quantities of phosphoric acid or alkalies must produce a beneficial effect. The poorer the soil the more striking will be the effect which the manure produces, and the more diluted may the latter be before it ceases to produce any visible effect. A liquid which is very poor in these fertilizing constituents, when applied to land which contains already potash, lime, phosphoric acid, and other mineral substances required by plants, though possibly in deficient quantities, may not make any perceptible impression, simply because it does not materially increase the original store of the available fertilising substances in the soil; whilst the same liquid, when put upon land that contains no phosphoric acid whatever, and a much smaller proportion of lime, potash, &c., than is contained in the liquid manure, will produce a striking effect, inasmuch as the fertilizing constituents in the manure materially increase the store of plant-food in the soil.

Several of the liquid manures which I examined, compared with other fertilisers, are poor manures. For the reasons just mentioned liquid manure of this description cannot produce any marked effect upon naturally fertile land, but on poor sandy soils it unquestionably may be used with very great benefit.

Nay, I think it can be shown (and experience confirms me in this) that liquid manure in a concentrated state would act injuriously upon the vegetation on most soils which are benefited by liquid manure, and that the more sterile and sandy the soil naturally is, the greater the necessity for diluting the manure.

Under ordinary circumstances it is the soil that furnishes to plants a considerable proportion of the mineral matters which are left behind on reducing them to ashes. As a rule the manure, in addition to nitrogenised substances and other organic constituents, is required to supply in preference those mineral matters which, like phosphoric acid or potash, are generally sparingly distributed through the soil. The natural resources of mineral plant-food vary greatly in quantity and in quality in different soils. In most, the more common fertilizing materials, such as lime and

magnesia, sulphuric acid, silica, and even potash, are found in such abundance, that we need not care to replace them in the measure in which they are carried off the land in the different crops of a rotation. There are *a few* soils upon which we can continue to grow paying crops of roots, clover, or corn, without restoring in the shape of manure the more valuable minerals, such as phosphoric acid; but where it is yet necessary to replace the nitrogenised food of plants, which, it appears, is diminished in a high degree by the growth of white crops. Upon land rich in available mineral matters, purely nitrogenised or ammoniacal manure may be used with far more safety (and in many instances with true and permanent economy) than upon soils deficient in available mineral food. The injurious effects of an excess of ready-formed ammonia and nitrogenised matters readily furnishing ammonia on decomposition, show themselves nowhere plainer than upon poor sandy soils. Daily experience tells us to use ammoniacal manures but sparingly in such cases. Now liquid manure, we have seen, always contains a considerable proportion of nitrogenised organic matters, as well as ready-formed ammonia, but it is deficient in phosphoric acid and other mineral matters which, under ordinary circumstances, are furnished to the plant by the soil. The liquid manure produced on a farm, when applied in a concentrated state, of course cannot penetrate the soil to any great depth, or, at any rate, cannot soak so deeply into the soil as it would had it been previously diluted with three or four times its bulk of water. There are many sandy soils in which lime, magnesia, phosphoric acid, and other minerals occur but in very small quantities. If such soils are manured with a too concentrated description of liquid manure, there will not be a sufficient quantity of mineral food in the soil and the manure to counterbalance the injurious effects which an overdose of purely nitrogenised food is well known to produce. Grass land under such circumstances will produce abundant, but rank, innutritious, bad-keeping hay; wheat will give abundance of straw, but little and inferior corn; swedes, turnips, and other root-crops will make rapid progress, and then become attacked by disease.

For these reasons it is necessary to dilute liquid manure largely if we wish to put it on poor sandy soils. Diluted with much water it penetrates a larger mass of soil, and, so to speak, becomes more saturated with the mineral fertilizing matters that are wanted by the plant, and are so sparingly distributed throughout the soil.

And this leads me to observe that liquid manure is particularly well adapted for porous sandy soils, because it penetrates them when properly diluted deeply and uniformly, which is a

great advantage, since the porous nature of sand allows the roots of plants to penetrate the soil to a great depth, and in every direction, in search of food. In other words, sandy soils are excellent vehicles for holding a diluted liquid manure, in which the different constituents occur in an immediately available, or, so to say, cooked condition.

The porous and often uniform physical character of such soils, moreover, causes great fluctuations in the amount of moisture, and in dry and warm weather they dry to a considerable depth, leaving a porous and friable surface exposed to the action of the atmosphere.

All these are peculiarities that strikingly characterise porous sandy soils, and render intelligible the improvement which liquid manure is well known to produce on them.

Let us contrast with these chemical and physical properties of sandy soils some peculiarities that are most distinctly observed in stiff clay land.

III. On the Characters of Soils not benefited by Liquid Manure, and on the Causes of Failure.

Soils containing a fair proportion of clay, especially stiff clay soils, are diametrically opposed in their chemical and physical characters to those which are porous and sandy. Generally the more retentive and stiff soils contain not only the more common mineral elements which we find in the ashes of plants, such as lime, magnesia, soluble silica, sulphuric acid, &c., in sufficient abundance, but also the more valuable mineral substances, such as phosphoric acid and potash. They moreover possess in a high degree the power of absorbing ammonia from the atmosphere, and retaining it; and in addition to this ammonia, under good cultivation, the vegetable remains left in such soils in the shape of roots and leaves from former crops, yield plenty of organic food for plants. It is true that stiff soils are not always very productive, but generally speaking they contain within themselves all the elements of fertility, and it is only for want of proper cultivation that their productive powers are not fully developed.

Whatever the agriculturist may think of the Lois Weedon system of culture, the Rev. Mr. Smith certainly has the great merit of having shown with indefatigable perseverance and zeal that certain clay soils only require constant working in order to yield remunerative crops of wheat in succession for a number of years. This would be an utter impossibility if they did not contain a practically inexhaustible store of mineral elements of nutrition, and if they did not under his system of cultivation also provide an ample supply of organic food.

In illustration of this part of my subject, I may mention the

following analysis, which I recently made of a soil and its subsoil of moderately retentive and naturally very fertile properties.

This soil and subsoil contained in 100 parts:—

		Surface soil.		Subsoil.
* Organic matter and water of combination ..		4·38		2·59
Alumina		2·15		5·39
Oxides of iron		3·15		7·16
Lime		·77		·26
Magnesia		·13		1·22
Potash		·49		·88
Soda		·13		·28
Phosphoric acid		·12		·19
Chlorine		trace.		trace.
Carbonic acid		·31		1·79
Insoluble silicates and sand	88·31		80·24	
Consisting of—				
Silicic acid		85·11		62·61
Alumina		2·36		14·55
Lime		.. ..		·85
Magnesia		·50		·23
Potash		·25		1·77
Soda		·09		·21
		100·00		100·00
* Containing nitrogen		·182		·09
Equal to ammonia		·220		·11

Submitted to a mechanical analysis these soils furnished:—

	Surface-soil.		Subsoil.
Sand	76·16	.....	55·15
Clay	18·09	.....	41·79
Lime, magnesia, &c.	1·37	.....	·47
Organic matter	4·38	.....	2·59
	100·00		100·00

The surface soil, it will be noticed, contains a considerable proportion of sand, whilst the subsoil contains less sand and more clay. We have here an example of a friable loamy soil resting on a stiffish clay subsoil.

It will be observed that the surface soil abounds in all the mineral matters which are required by cultivated plants, and also contains an appreciable quantity of nitrogenized organic matters. If we calculate the total amount of the available fertilising substances for a depth of soil of only 10 inches, we shall find a quantity of mineral and organic fertilising matters, in comparison with which the amount of manuring constituents supplied in 50,000 gallons of liquid manure (even more concentrated than Mr. Mechi's tank-liquid) appears altogether insignificant. I believe this to be the chief reason why little benefit results from the application of liquid manure to clay soils and fertile friable loams. It may be said, if these soils abound in

available fertilising substances, how is it that upon them ordinary farmyard manure is employed with advantage? To this objection I would reply: Farmyard manure, in the first place, is a more perfect manure than liquid manure, inasmuch as it contains a considerable proportion of soluble and insoluble phosphates which are very deficient in liquid manure, and, being a bulky manure, performs important mechanical functions that cannot be realised by the use of a liquid. In the second place, I would observe that the retentive physical characters of clay soils preclude the young plant from availing itself of the total amount of fertilising matters dispersed through the whole mass of the soil. In fact, plants growing on stiffish soils feed only upon a very small proportion of the bulk of soil; whilst those grown on a porous sandy soil penetrate it to a greater depth and in every direction, and avail themselves of the manuring constituents uniformly distributed amongst a large bulk of soil by the agency of liquid manure. In short, a porous sandy soil is a more appropriate vehicle for holding liquid manure. I indeed believe that little benefit would arise from the application of solid manure to clay soils, if it were possible to incorporate it with the soil as uniformly as liquid manure, and to the same depth to which the latter penetrates them. But decided benefit results from a good dressing with ordinary yard-manure, because, in fact, only a small proportion of the soil is actually manured, and because by the very bulk of the manure the physical and chemical characters of a portion only of the soil are so altered that in reality the plant feeds upon a new and artificially-formed soil.

However, it is not every clay soil that encloses in its substance abundant stores of plant-food; there are poor clays as well as poor sandy soils, and it may be asked, Might not liquid manure produce a good effect upon sterile clay land? I do not think it would produce a very marked effect, for I conceive that the close texture, coldness, and want of porosity which characterize sterile clays, are opposed to the successful application of liquid manure. As just observed, only a small portion of such soils can be penetrated by the tender roots of plants, whilst by far the larger part of the soil enriched by the liquid manure is out of their reach. Consequently most of the liquid manure would be lost under these circumstances, and the small quantity left in the portion of soil penetrated by the roots cannot of course produce any very striking result.

Moreover, all clay-soils are generally more than sufficiently wet during the early part of the year; the additional quantity of water supplied in liquid manure renders them wetter still; and as much heat is absorbed during the evaporation of water, the injury done to the land by the resulting cold would not, I imagine, be

counterbalanced by the small proportion of fertilising matters supplied.

Again, clay soils, whether fertile or barren, and all land that is moderately stiff, like the majority of soils in England, must by a heavy dose of liquid manure be rendered closer. Such soils certainly would not be improved in their physical character by an excess of water. The use of liquid manure at a time when such land is more than sufficiently wet is therefore objectionable. But it is equally objectionable when stiff soils get too dry. In summer soils of that description crack in all directions, and the liquid manure then runs through the cracks instead of passing through the soil, or it moistens the soil but very imperfectly. Much of the liquid manure is thus lost, and, moreover, injury is done by the insufficient proportion of manure that is absorbed by a thin layer of the surface soil, for it causes at first a more rapid development of the young plants, which receive a sudden check as soon as the small quantity of moisture is all evaporated.

We thus observe that, generally speaking, neither the chemical nor physical characters of clay soils, and others partaking more or less of the same nature, are favourable to the introduction of the system of liquid manuring. And since by far the greater part of the cultivated land in this country is more or less retentive, I feel assured that liquid manure will never be extensively employed by British agriculturists, but that its use will be confined to land of a light porous character.

The experience of those who profess to have used liquid manure with much benefit on clay land may be regarded as contradictory to my views on the subject. But I would observe that, as far as I could learn, the application of liquid manure on heavy land, where it is said to have produced astonishing results, was always preceded by thorough draining, subsoil ploughing, deep cultivation, clay-burning, and liming, each of which processes is well known to effect radical changes in the constitution of heavy land. Bearing in mind the experience of Mr. Smith of Lois-Weedon, and others who have practically tested the utility of deep cultivation; and on the other hand the failures of those who have applied liquid manure upon land not previously improved by any other process than thorough drainage, it appears to me, to say the least of it, doubtful, whether the improvements in such soils are due to the application of liquid manure, or to the processes of subsoiling, liming, and burning. Any one of these processes effects a radical improvement in heavy land, and much more conspicuous will the improvement be if all three are resorted to in succession, which was the case in one instance that has come under my notice.

In conclusion I offer some remarks—

IV.—On the Modes of Disposing of Liquid Manure.

With respect to the disposal of the liquid manure produced on a farm, I have come to the conclusion that on porous, sandy, naturally unproductive soils, the liquid excrements of animals are best disposed of, together with the solid excrements, by mixing both with much water and irrigating the land with such liquid manure. Where plenty of water can be obtained at a moderate expense, and where facilities exist for irrigation by gravitation, so that no expenses have to be incurred for the erection of steam-pumping engines and underground pipes, I believe that this will be found incomparably the most effective and economic mode of manuring the land.

But instances are comparatively rare in this country where the liquid and solid excrements can be disposed of together with advantage. The question therefore arises, how should liquid manure be disposed of on clay soils, and on land such as we frequently find it, that is neither so stiff as clay nor so loose in texture as sand.

This question involves the consideration of several purely practical matters. Thus, for instance, the quantity of liquid manure produced on a farm must necessarily influence a farmer in his proceedings; if there are only a few thousand gallons of liquid manure produced, it will of course not pay to construct an expensive tank and lay down pipes, whilst on another farm it may be good policy to collect the liquid in a water-tight tank. Again, a proper answer to this question cannot be given, unless it is stated whether fattening stock or young cattle are chiefly kept on a farm, or whether the farm consists chiefly of arable or pasture land, or whether most of the fields are light or heavy, whether much or little straw is produced, and in what way the straw is disposed of with most benefit. Such and similar considerations must necessarily influence the arrangements for collecting and disposing of the excrementitious matters produced on a farm. Nothing therefore can be more absurd than to lay down a fixed rule for the management of liquid manure. On one of my agricultural excursions I remember having visited a farm where I found the liquid-manure tank brim-full. On inquiry what was done with the tank liquid? I was told, "Nothing." This appeared to me a strange answer, and I was half inclined to consider my host behind the times. However, knowing him to be a remarkably intelligent and thoroughly practical man, I did not jump at once to such a hasty conclusion, but endeavoured to learn from him all the particulars which led him at first to erect a tank, and afterwards to allow the liquid manure to run over and find its way into the soil as best it could. The

result of a morning's ramble over the whole of the farm, and an animated discussion afterwards between us, was, that I thought with my friend that the most practical mode of disposing of the liquid manure in this case, was to let it run away "as fast as it would." I trust I may not be understood as advocating this novel, and I believe by no means uncommon, method of dealing with the contents of liquid-manure tanks on heavy clay farms. We cannot avoid recognising in this practice a waste which, no doubt, may be avoided, but which, under peculiar circumstances, is an evil that is more economically endured than cured.

Disclaiming, therefore, the intention of laying down fixed rules for the management of liquid manure, and avoiding the consideration of many practical matters, I propose to point out, by way of example, one circumstance which I believe more than any other must affect the arrangements on a farm for disposing of the liquid excrements of animals.

There are three modes of disposing of the liquid excrements of animals on soils on which irrigation with liquid manure cannot be carried out with advantage :—

1. Where the urine of animals is completely absorbed by litter in feeding-boxes.

2. Where the urine and drainings of stables, cowhouses, and pigsties, are collected in a small tank in close proximity to a *covered* manure-pit.

3. Where the liquid excrements of domestic animals, the sewage of dwelling-houses, drainage-water, and every kind of animal refuse matter are collected together in a water-tight tank of larger capacity, situated, as in No. 2, close to the manure-pit.

I assume that the manure-tank in Nos. 2 and 3 is provided with a forcing-pump, by means of which the tank liquid can be spread over the solid manure, as occasion requires.

In no instance would I recommend that the liquid collected in the tank should be applied by itself. Manure I believe ought either all to be used in a liquid form or all in a solid state. I consider it decidedly a bad practice to employ separately the solid and the liquid excrements of animals.

The adoption of one or the other of these three modes of dealing with liquid manure must depend chiefly on the *supply of straw.*

On farms where no young stock is kept, and just enough straw is produced to provide fattening cattle and horses with the requisite quantity of chaff and a sufficient amount of bedding material, I believe the best mode of disposing the liquid and solid excrements is to make the manure in boxes.

In well-managed box-feeding there is no waste by drainage of the most valuable portion of manure, nor waste by evaporation of

ammonia; the manure ferments regularly and slowly, and liquid and solid excrementitious matters, which are neither of them perfect manures when applied separately, are preserved together in the most admirable manner. But on many farms the whole of the manure cannot be made in boxes, for on some there is too *little* straw produced, and only some of the cattle can be kept in boxes. In other places the farmer has so *much* straw that he finds it difficult to dispose of; he can neither sell the excess to advantage nor make it all into manure in fattening-boxes.

In the former case, that is when straw is deficient, I would suggest that the urine of cattle should be conducted through iron pipes into a perfectly water-tight tank, placed in the midst of the dung-steading, or close to one side of it. Let the manure-pit be covered by a roof, supported by several upright poles. Such a roof perhaps might be cheaply made of asphalted felt—a material that is both waterproof and light. A roof made of this material would not I imagine take very stout posts for supports, and could be erected at quite a cheap rate. The four sides of this erection would be of course left open, so that the wind could sweep over the manure in the pit in every direction.

Care should be taken to prevent the water from the roofs of farm-buildings and cattle-sheds from finding its way into the liquid-manure tank. Unless the tank is perfectly water-tight, and the urine of the stables and cowhouses conducted through iron or stoneware pipes, it is hardly possible to exclude drainage-water. By adopting this course, only the urine of cattle, saturated more or less with solid excrements, will find its way into the tank, and a comparatively small quantity of liquid will collect in it. The liquid, being concentrated, will rapidly enter into fermentation, and will lose ammonia by evaporation. It is, therefore, desirable that some oil of vitriol be poured into the tank from time to time, or whenever a pungent smell is discernible. According to the size of the tank 5 to 10 lbs. of oil of vitriol may be poured into it perhaps every two or three months. By this inexpensive and most effectual mode of preventing loss in ammonia, the manure may be wonderfully improved.

The solid manure in the pit, being sheltered against rain, rapidly gets drier, for during the fermentation of dung heat is developed, which is spent in the conversion of a considerable portion of the water of the manure into vapour.

As it is of much consequence to ferment manure with regularity, and fermentation is almost altogether stopped when excrementitious matters and straw are completely immersed in water, it is advisable to give the dungpit a somewhat inclined position, and to lay down an iron pipe close to the bottom of the pit, and to carry by this means any excess of liquid back into the tank. If

this arrangement be adopted, the liquid in the tank may frequently be pumped over the manure in the pit without doing any harm, which it would be sure to do if no provision were made for the excess of liquid to drain back into the tank. This is of particular importance on farms where cattle, for want of straw, are insufficiently littered, and the manure consequently is very wet. The bulk of the solid manure, as well as the quantity of absorbing materials, might be considerably increased if coal-ashes, dry sawdust, and dry refuse matters of every description, and even dry earth, were thrown upon the manure-heap; and I feel convinced that, with a little care and management, the whole of the liquid excrements might gradually be absorbed and incorporated with the solid manure and litter.

The third plan of disposing of liquid manure is most beneficially adopted on farms upon which much more straw is produced than can be sold or consumed in feeding-boxes. On many farms in the neighbourhood of Cirencester it is impossible to convert in boxes the excess of straw into manure. There is not sufficient moisture to rot the straw.

On our own farm we have so much straw in the manure that it would not ferment properly if it were not exposed in the manure-pit to the rain that falls, and if it were not besides moistened with the sewage that flows from the College into the liquid-manure tank. Where there is an excess of straw, no difficulty exists of disposing of liquid manure, since the straw is capable of taking up more liquid than is supplied in the urine of animals. For this reason it is of no use to erect a roof over the manure-pit on farms where a large excess of straw is employed in the making of manure. On such farms I think no sensible man would contemplate for a moment the introduction of the system of liquid manuring.

Royal Agricultural College, Cirencester,
December, 1858.

XXV.—*Report of Experiments with different Manures on Permanent Meadow Land.* By J. B. Lawes, F.R.S., F.C.S., and Dr. J. H. Gilbert, F.C.S.

Part I.—Produce of Hay per Acre.

The extent of land in this country in Permanent Grass, and the importance of the crop, both as regards its yield of food for animals, and its relations, under existing circumstances, to the crops under tillage, establish for it a high claim to investigation, with a view to increased productiveness. In several of its

aspects—and in some involving its most intricate relations—the subject has received the attention of investigators at once competent and laborious. The pages of the 'Journal of the Royal Agricultural Society of England' sufficiently bear out this statement. Among them are to be found valuable records of practical observation, and experience, as to the distribution, the adaptation, and the comparative utility, of the most important plants composing this heterogeneous crop, according to character of soil, climate, and other circumstances.* We have elaborate examinations by Professor Way, into the composition of the several plants, each grown under circumstances favourable to its development, and all taken as far as possible at an equal stage of growth.† And in the last Number of the Journal will be found three Papers, each of great but distinctive value, bearing upon the practical management and manuring of the Grass crop.

As the title of the present Paper will indicate, its scope and objects are sufficiently distinct from those of the inquiries above alluded to. And, whilst the plan of the investigation which has been undertaken, and the character of the data which it has afforded, will necessarily lead to a somewhat special treatment of the subject, we shall endeavour, as far as circumstances will permit, to pay due regard to what appears to have been established hitherto.

An inquiry into the comparative effects of different manuring substances upon permanent grass, has, however, other grounds of interest than such as relate merely to determining the best means of increasing the gross amount of its produce. There is perhaps no crop more influenced in its *character*, as well as its *quantity*, by the attention bestowed upon it. Our Grass-crop comprises, as is well known, not only a great number of genera and species belonging to the *Graminaceous* family — the Natural Grasses commonly so called—but also various members of other families of plants, among which, by far the most important is the *Leguminous*. It so happens, then, that in our Meadows and Pastures there are associated members of those two families of plants that afford us the crops which are not only the most important among those which enter into our rotations, but which, as there grown separately, and in alternation, exhibit very characteristically different degrees of dependence upon the direct artificial supply of some of their constituents; and coincidently with this, show very distinctive relationships to one another in the course of cropping.

* See 'Prize Report,' by Mr. John Bravender, Jour. Roy. Ag. Soc., vol. v.: also Papers by Professor Buckman, Jour. Roy. Ag. Soc., vol. xv. p. 462; vol. xvii. p. 162; and vol. xvii. p. 513.

† Jour. Roy. Ag. Soc., vol. xi. p. 530, and vol. xiv. p. 171.

Thus, Wheat, Barley, and Oats are of the *Graminaceous* family, and have, therefore, so far, their points of close relationship with the so-called "Natural Grasses." Beans, Peas, and the cultivated Clovers, Lucerne, &c., of our rotations, are, on the other hand, of the *Leguminous* family; and hence their relationship to the clovers, and allied plants, of our Meadows and Pastures. It is true that the circumstances of growth, and the treatment, of the plants composing the mixed herbage of our Pastures and Meadows, are widely different from those of the allied plants—especially of the seeding ones—in our arable fields. In the one case, too, the plants are chiefly perennial, and in the other chiefly annual. It might well be expected, therefore, that, notwithstanding their natural alliances, crops which differ so widely both in certain comparatively incidental conditions of growth, and in some intrinsic qualities, should, at the same time, manifest somewhat different manurial requirements.

Among the most interesting of the points incidentally brought out by the experiments which form the subject of the present Report, is the striking confirmation which the results afford of the (so to speak) special adaptation, in a course of practical agriculture, of certain constituents of manure, to the growth of certain of the crops of our rotations, accordingly as they belong to the one or to the other of the two great families of plants above referred to. That is to say, the comparative action of different descriptions of manure, upon the development of the different plants of the mixed herbage of our Meadow, was found to accord with, and further to illustrate, points independently established regarding the manurial requirements, and the mutual relations, of the plants of our rotations to which they are botanically allied. At the same time, independently of the difference in other conditions of growth and management, the permanent and alternating crops generally differ so widely, both in regard to the amount of certain constituents which they respectively remove from the land, and to the proportion of these which will probably be in due course returned in the home manures, that the character of the supplementary manures required by even much allied crops, must obviously be somewhat different in the two cases.

To turn to the experiments themselves: The plan adopted was, to apply a number of different combinations of manuring substances, each, year after year, to the same plot of land. And in order to provide proper standards of comparison, two plots were left continuously unmanured, and another portion was annually manured with farm-yard manure.

The land selected comprised about 6 acres of the Park at Rothamsted, and it had been under permanent grass for certainly

more than a century; indeed, for as long a period as is included in any record that can be found relating to it. The general mode of treatment for many years prior to 1851, was to manure occasionally with farm-yard dung, road scrapings, and the like; and sometimes with Guano, or other purchased manure. One crop of Hay was removed annually, amounting in weight to from $1\frac{1}{4}$ to 2 tons per acre; and the second crop was always eaten off by sheep. In the spring of 1851, and again in that of 1852, 4 separate acres of the allotted area were appropriated to the consumption by sheep of as many lots of differently manured turnips; 10 tons of the roots being eaten upon each acre. Neither the 4 acres so appropriated, nor the remaining 2, were manured in any other way in those two seasons; nor were they manured at all in the three succeeding ones prior to the commencement of these experiments in 1856. It should be mentioned too, that the consumption on the land of the different turnips did not in any case increase the produce over the 5 years, 1851–5 inclusive, by more than about 2 cwts. per acre annually. The land is a somewhat heavy loam, with a red clay subsoil resting upon chalk; and although not artificially is very well naturally drained. The area selected was perfectly level. Lastly, no fresh seed of any kind has been sown either within the period of the experiments, or for many years before it.

Early in 1856, 9 plots, of half an acre each, were measured off for as many different combinations of so-called artificial manuring substances; 2 of a quarter of an acre each, to be continuously unmanured; and 2, also of a quarter of an acre each, to be manured annually with farm-yard dung. In 1858, 4 additional plots, of one-sixth of an acre each, were appropriated to trials with nitrate of soda; the land so selected having been unmanured for several preceding seasons. The description, and quantities per acre, of the different manures employed, are given in the Tables, by the side of the results they yielded; but it will be well to state them here, at one view, a little more fully than there is there room to do.

Plot 1. Unmanured.

Plot 2. Unmanured (duplicate plot at the further end of the series).

Plot 3. 2000 lbs. sawdust.

Plot 4. 200 lbs. each sulphate and muriate ammonia (good samples of the salts so named in commerce).

Plot 5. 2000 lbs. sawdust, and 200 lbs. each sulphate and muriate ammonia.

Plot 6. 275 lbs. nitrate of soda.*

* The experiments with nitrate of soda did not commence until the third season, 1858.

Plot 7. 550 lbs. nitrate of soda* (equal in nitrogen to the ammoniacal salts of plot 4).

Plot 8. Mixed mineral manure, composed of—

200 lbs. bone ash	superphosphate of lime.
150 lbs. sulphuric acid (sp. gr. 1·7	
300 lbs. sulphate of potash.†	
200 sulphate of soda.†	
100 lbs. sulphate of magnesia.†	

Plot 9. "Mixed mineral manure," as plot 8, and 2000 lbs. sawdust.

Plot 10. "Mixed mineral manure," as plot 8, and 200 lbs. each sulphate and muriate ammonia.

Plot 11. "Mixed mineral manure," as plot 8, 200 lbs. each sulphate and muriate ammonia, and 2000 lbs. sawdust.

Plot 12. "Mixed mineral manure," as plot 8, 200 lbs. each sulphate and muriate ammonia, and 2000 lbs. cut wheat-straw.

Plot 13. "Mixed mineral manure," as plot 8, and 400 lbs. each sulphate and muriate ammonia.

Plot 14. "Mixed mineral manure," as plot 8, and 275 lbs. nitrate of soda.*

Plot 15. "Mixed mineral manure," as plot 8, and 550 lbs. nitrate of soda* (equal in nitrogen to the ammoniacal salts of plots 4, 10, &c.).

Plot 16. 14 tons farm-yard dung.

Plot 17. 14 tons farm-yard dung, and 100 lbs. each sulphate and muriate ammonia.

It would have been desirable to have had some plots with the superphosphate of lime, and the mixed alkali-salts, used separately; but it was considered, that to increase the number of the experiments, would be to extend the series beyond convenient practicable limits.

The artificial manures were, for the purpose of equal distribution, mixed with ashes prepared by burning soil with a portion of weeds and turf. They were sown broadcast. The date of sowing was, in 1856, the middle of February; in 1857, the 24th February; and in 1858, the 31st of March; excepting that the nitrate of soda (used in 1858 only) was not applied until the 8th of April. The farm-yard manure and the sawdust, excepting in the first season, were put on in the previous November or December.

The first crop only, in each year, was mown; and the produce

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* The experiments with nitrate of soda did not commence until the third season, 1858.

† The sulphates of potash and soda used, are the rough commercial articles; the sulphate of magnesia, Epsom salts.

of each plot was weighed separately as *hay*, at the time of being carted to the rick. The second crop was eaten off by sheep having no other food; each plot, according to the bulk of its produce, having a given number penned upon a portion of it, the area being extended, day by day, as the feed was eaten down. To the further particulars of the feeding, and to the estimates made of the produce of the second crop, we shall recur presently.

The weight of hay (one cutting) taken from the different plots, in each of the 3 seasons, is given in Table I., p. 558.

Although the three seasons over which the experiments have extended differed widely one from another in climatic characters, the amounts of *gross produce*, under equal conditions of manuring, were upon the whole much the same in the three seasons. There was indeed a tendency to increase, from year to year, as the experiments proceeded; but this tendency is the more apparent when the acreage amounts of *dry matter*, instead of gross produce of hay merely, are considered. Viewed in this way, the increase was moreover much greater in the second year as compared with the first, than in the third as compared with the second. It was too, perhaps upon the whole, the more marked where the most liberal manuring was employed, and the largest crops thereby obtained. On this point it should be remembered, that the manure from the sheep consuming the second crop, so far as it was due to the residual manures applied for the preceding first crop, would be so much addition to that supplied for the first crop of the succeeding season; and that the addition would be the greater, the more liberal had been the manuring, and the larger the amount of after-grass. It would too, with excess of manure, be somewhat cumulative, and relatively the more so, the more excessive the manuring, and the greater the produce of after-grass. The difference in the produce by the same manure, in one season compared with another—at any rate the increase in the amount of it in the second year of manuring over that in the first—cannot therefore be *wholly* attributed to differences in the characters of the seasons themselves.

With regard to the seasons themselves, a few general observations may nevertheless be made. The growing period of the first season, 1856, was generally much colder and wetter than that of either 1857 or 1858. Its rain was in April above the average, in May very large, and in the final month, June, but small. The moisture in the atmosphere, as indicated by the dew-point, was generally comparatively low; and with this the range of temperature above that point was also low.

The grass season of 1857 ranged higher both in maximum and in minimum temperatures, and also in mean range, than that of 1856; and in that of 1858 higher numbers still were registered in

Experiments with Different Manures on Permanent Meadow Land.

Table I.—Produce of Hay per Acre: tons, cwts., qrs., and lbs.

Plot, Nos.	MANURES. (Per Acre, per Annum).	Annual Produce. 1856. Cut June 25; carted July 1.	1857. Cut June 23; carted Ju. 26-27.	1858. Cut June 26; carted Ju. 29-30.	Average of 3 Years.	Average Annual Increase or Loss by Manure.
	Series 1.—Without Direct Mineral Manure.					
		tns. cwt. qrs. lb.	tns. cwt. qrs. lb.	tns. cwt. qrs. lb.	tns. cwt. qrs. lb.	tns. cwt. qrs. lb.
1	Unmanured	1 2 1 23	1 5 2 0	1 2 0 8	1 3 1 10	. .
2	Unmanured (duplicate plot)	1 0 3 27	1 3 0 16	1 10 0 0	1 4 2 24	. .
	Mean, or Standard Unmanured	1 1 2 25	1 4 1 8	1 6 0 4	1 4 0 3	. .
3	2000 lbs. Sawdust	1 0 2 16	1 0 3 16	1 0 0 4	1 0 2 3	−0 3 2 0
4	200 lbs. each, Sulphate and Muriate Ammonia	1 15 3 24	1 13 2 22	1 15 2 6	1 15 0 8	0 11 0 5
5	200 lbs. each, Sulphate and Muriate Ammonia, and 2000 lbs. Sawdust	1 15 1 5	1 13 0 14	1 17 0 22	1 15 0 14	0 11 0 11
6	275 lbs. Nitrate of Soda*	. .	.	1 6 1 12	. .	0 2 1 9
7	550 lbs. Nitrate of Soda*	. .	. .	1 11 3 8	. .	0 7 3 5
	Series 2.—With Direct Mineral Manure.					
8	"Mixed Mineral Manure"†	1 10 2 13	1 12 2 26	1 16 1 22	1 13 1 2	0 9 0 27
9	"Mixed Mineral Manure," and 2000 lbs. Sawdust	1 13 0 15	1 15 2 18	1 19 0 8	1 15 3 23	0 11 3 20
10	"Mixed Mineral Manure," and 200 lbs. each, Sulphate and Muriate Ammonia	2 16 3 7	2 17 1 10	3 4 0 4	2 19 1 16	1 15 1 13
11	"Mixed Mineral Manure," 200 lbs. each, Sulphate and Muriate Ammonia, and 2000 lbs. Sawdust	2 16 3 13	2 17 1 16	3 1 2 4	2 18 2 11	1 14 2 8
12	"Mixed Mineral Manure," 200 lbs. each, Sulphate and Muriate Ammonia, and 2000 lbs. Cut Wheat Straw	2 8 1 8	2 14 0 2	3 0 1 4	2 14 0 23	1 10 0 20
13	"Mixed Mineral Manure," and 400 lbs. each, Sulphate and Muriate Ammonia	3 2 0 26	3 1 3 24	3 7 0 4	3 3 2 27	1 19 2 24
14	"Mixed Mineral Manure," and 275 lbs. Nitrate of Soda*	. .	. .	1 17 3 8	. .	0 13 3 5
15	"Mixed Mineral Manure," and 550 lbs. Nitrate of Soda*	. .	. .	2 10 1 8	. .	1 6 1 15
	Series 3.—With Farmyard Manure.					
16	14 tons Farmyard Manure	1 15 3 26	2 7 2 8	1 17 0 20	2 0 0 27	0 16 0 24
17	14 tons Farmyard Manure, and 100 lbs. each, Sulphate and Muriate of Ammonia	2 4 2 25	2 13 2 16	2 7 2 0	2 8 2 14	1 4 2 11

* The experiments with Nitrate of Soda were not undertaken until the third year (1858), and the land devoted to it had been unmanured during several preceding seasons.
† For further description of this, and other manures, see page 556.

in regard to these several characters; but especially to that of the maximum temperature of the final month June, which in this third season, 1858, was very excessive. Both in amount and distribution of rain, April differed not very materially in the three seasons. May, as already mentioned, gave in 1856 a very large amount of rain, and also a large number of rainy days. In the same month of 1857, with at the same time much higher temperatures than in 1856, both the actual fall, and the distribution of rain, were very small. In May of 1858, again, with still higher temperatures than in the same month of 1856, both the actual amount and the distribution of rain were pretty full. In June, 1856, with again lower temperatures than in the other years, there was, after the very wet May, now but very little rain. In the warmer June of 1857 there was a fair amount of rain; and in the still hotter June of 1858 there was, after a moderately wet May, but little rain.

The three seasons were therefore very different from one another, both in actual character as to heat and moisture, and in the mutual adaptations of these two qualities. As has been observed, however, the gross amount of the heterogeneous produce —*hay*—did not differ very widely in the three seasons; though the acreage amount of *dry matter*, and consequently of carbon assimilated, was nevertheless notably less in the first, and colder and wetter season 1856, than in either of the others. And, as will afterwards be seen, with the prevailing wet and cold of 1856, the percentage of dry matter in the produce was low, and that of the mineral matter, and of the nitrogen in that dry substance, high—characters which indicate comparatively backward conditions as to the stage of growth and the maturation of the plants. In a subsequent division of this Report we shall illustrate by pretty full detail on the point, the fact that the proportions of the different descriptions of herbage, as well as the character of the development of each, were very much affected within equal periods of the season, according to the kind of manure employed. Had we equal means of deciding upon the varying character of the produce dependent on the varying character of the seasons, there can be little doubt that the produce of these three very different seasons would show great differences, both as to the relative amounts of the various plants developed, and as to the character of the development of each.

Directing attention now to the comparative effects of the different *manures*, little more need be said as to the produce of the individual seasons. The results, as between one condition of manuring and another, will be both better and more easily

traced by confining attention to the column showing the *average annual produce over the 3 years*, and to the concluding one of the Table (I.) showing the *average annual increase by manure.* These records relate, as will be remembered, to the produce of one cutting only. An estimate will be given further on, as to the actual and relative amounts of hay, to which the after-feed on the several plots was probably equivalent. At present it is only necessary to consider how far the consumption of the after-grass upon the land should influence the judgment to be formed of the effects of the different manures according to the weights of the produce of the first crop alone. On this point it may be remarked, that the knowledge we possess as to the average proportion of the nitrogen and of the mineral matter of the food consumed by stock, which they probably finally store up in their bodies (and in the case of nitrogen exhale), is such as to lead to the conclusion that the land would lose comparatively little of these manuring substances by the consumption upon it of the after-grass by sheep. By far the larger proportion of these contained in the second crop of one year would, therefore, remain towards the produce of the first crop in the succeeding year. Taken over a series of years, the annual produce yielded in the first crop will thus pretty closely represent the average annual result of the manure on any particular plot; at any rate sufficiently so for a general comparison of the effects of one manure with that of another.

On one of the unmanured plots the average annual produce of hay was 1 ton 3 cwts. 1 qr. 10 lbs.; and it varied but little from year to year. The duplicate unmanured plot was somewhat shaded from the afternoon sun. It gave in the first two years about 2 cwts. less of hay annually per acre than the other, but in the third year as much as 8 cwts. of hay more. The fact was, as the result of the after-feeding showed, that this second plot, though it gave less mown hay in the first two years than the first plot, gave, on the other hand, more aftergrass in those years. Hence there was less removal from the land in the first two years; and, compared with the other plot, some accumulation of manuring matter for the first crop of the third season. The average annual yield of mown hay on the duplicate plot was, however, only $1\frac{3}{8}$ cwts. more than on the other. The mean of the two may therefore be fairly taken as the average annual yield of the land and seasons in question. This amounted to 1 ton 4 cwts. and 3 lbs. of hay, as the *standard unmanured produce* of the experimental meadow-land.

Sawdust contains very little of either nitrogen or mineral matter; but, upon high authority, it has been stated to produce great effects as manure, by virtue of the solvent action of the car-

bonic acid it yields in its decomposition, upon the mineral constituents of the soil. The plot where there were employed per acre annually 2000 lbs. of sawdust (containing 4 to 5 lbs. of nitrogen), yielded, however, an average annual produce of about 3½ cwts. *less* hay than the unmanured land. Where 2000 lbs. of sawdust were employed *with ammoniacal salts* (Plot 5), there were only 6 lbs. per acre per annum more produce than where the same description and amount of ammoniacal salts were used alone (Plot 4). When the same amount of sawdust was added with a liberal mineral manure (Plot 9), the mixture gave annually about 2⅝ cwts. more hay than when the same mineral manure (Plot 8) was used alone. Lastly, when the sawdust was employed in admixture with both the ammoniacal salts and the mineral manure (Plot 11), the produce per acre per annum was about ¾ cwt. less than when the same ammoniacal salts and mineral manure (Plot 10) were used without the sawdust. The nearly a ton per acre per annum of organic matter rich in carbon, in the form of sawdust, was then practically of no avail.

As the previous enumeration and the Table show, the ammoniacal salts employed consisted of an equal mixture of the sulphate and the muriate of ammonia of commerce. This mixture is reckoned to contain about 25 per cent. of ammonia, which is equal to about 20·5 per cent. of nitrogen. The 400 lbs. of ammoniacal salts per acre per annum, as used on several of the plots, would therefore bring annually on to the land about 100 lbs. of ammonia.

Where the 400 lbs. of ammoniacal salts were used alone (Plot 4), they gave an average annual *increase* of 11 cwts. of hay. The average annual *produce* by the ammoniacal salts was 1 ton 15 cwts. of hay.

The "*mixed mineral manure*" alone (Plot 8), which contained an ample supply of acid—phosphate, and sulphate of lime, and of potash, soda, and magnesia, in the form of sulphates, but which did not afford, in a direct manner, an increased supply of available silica, gave an average annual increase of about 9¼ cwts. of hay per acre.

The ammoniacal salts alone, it has been seen, gave an annual increase of 11 cwts. of hay; only 1¾ cwt. more, therefore, than purely mineral manures. It will be shown, however, in some detail in a subsequent section, that the description of the increase differed extremely in the two cases. In fact, where the ammoniacal salts were employed, the increase was exclusively due to the increased growth of *Graminaceous plants*—the so-called *Natural Grasses*—there being scarcely a *Leguminous* plant to be found upon the plot. Where the purely mineral manures were used, on the other hand, the *Grasses*, properly so called, were

observed scarcely to have increased at all; whilst the whole plot was thickly covered with Perennial Red Clover (*Trifolium pratense perenne*) and some other Leguminous plants. Such a result is perfectly consistent with what has been before established regarding the (so to speak) characteristic adaptation of mineral and nitrogenous manures respectively, to those crops of the respective families which are grown in our rotations.

Mineral manures alone have then much increased the growth of the Leguminous plants on the meadow land. They enabled the Graminaceous ones, on the other hand, to assimilate but little more of nitrogen or carbon from natural sources, than did the normal supply of available mineral constituents in the unmanured land. Very different was the action of mineral manures upon the growth of the Graminaceous plants of the Meadow, when those manures were associated with a liberal artificial supply of *available nitrogen.* In the case of experiments both upon Wheat and upon Barley, too, it has been shown that the land experimented upon was competent, for a series of years, to yield up annually enough of mineral constituents for a considerably larger crop than could be grown under the influence of the annually available natural supplies of nitrogen alone. The annually available mineral constituents were, however, not sufficient for such full crops as the seasons would yield, *when there was a liberal artificial supply of available nitrogen.* There appear to be obvious reasons why this should be expected to hold good to a greater extent with Meadow Grass than with these Graminaceous corn crops. In land of pretty equal original characters, the amount of mineral matter taken annually from a given area in Grass (mown for hay) is, under the same annual climatic circumstances, much greater than that taken off in the corn and in the straw of the seeding crop. The mechanical operations, and the exposure to the atmosphere, in the case of the arable land, would appear to indicate a greater annual disintegration and liberation of total mineral constituents over a given area, though not perhaps more within the limits of the immediately superficial layers. In the case of Meadow Grass, therefore, the original characters of the soil, and the seasons, being equal, both the annual demand for mineral constituents would be greater, and the total annual yield of them from the soil would be less, than in the case of the cereal crop.

Consistently with the foregoing considerations, it was found, that although the ammoniacal salts when used alone gave an annual increase of only 11 cwts. of hay, the same amount of ammoniacal salts, when in conjunction with the "*mixed mineral manure*" (Plot 10), gave an annual increase of 1 ton $15\frac{3}{8}$ cwts. of hay. Thus, the combination of ammoniacal salts and the

mixed mineral manure gave more than three times as much increase as the ammoniacal salts alone, and four times as much as the mineral manure alone. The average annual produce, by the mixture of the ammoniacal salts and mineral manure, amounted in fact to within less than a hundredweight of 3 tons of hay per acre, by the side of 1 ton 4 cwts. per acre on the continuously unmanured land.

Now, this produce, by the mixed mineral manure and ammoniacal salts (Plot 10), consisted almost exclusively of Graminaceous plants. There was scarcely a clover, or any other Leguminous plant, to be found upon the plot. The action of the mineral manures, in this conjunction with ammoniacal salts, was *not* therefore to yield increase by aiding the development of Leguminous plants, as was the case when the same mineral manures were used alone. The mineral manure has now acted by supplying, within the reach of the plants, a sufficiency of certain mineral constituents, to enable the Graminaceous plants to appropriate, and turn to the account of growth, a much larger portion of the *artificially supplied nitrogen* than they could do when the ammoniacal salts were used alone. In fact, there were 1 ton $4\frac{1}{4}$ cwts. per acre per annum more Graminaceous hay grown when the artificial supply of nitrogen was accompanied by a liberal artificial supply of certain mineral constituents, than when it was not so accompanied.

It has been shown that the mineral manures had little or no effect in increasing the assimilation of nitrogen by the Meadow Grasses, when that constituent *was not artificially supplied.* On the other hand, they very considerably aided that assimilation, when available nitrogen *was artificially supplied.* It has also been shown that the addition to the mixed mineral and nitrogenous manure of a large quantity of sawdust—a substance rich in carbon—did not further increase the produce. In fact, neither did the sawdust (whether alone or in admixture) seem to aid the solution of mineral constituents by the evolution of carbonic acid; nor did this possible source to the plant of carbonic acid itself seem to have been of any avail. The addition to the mixed mineral and ammoniacal manure, of an equal weight of cut wheat-straw instead of sawdust (Plot 12), was equally without effect with that of the latter substance. Indeed, notwithstanding the large amount of mineral constituents, and especially of silicious compounds, contained in the cut wheat-straw, as compared with the sawdust, there was, whether compared with the produce by the mixed mineral and nitrogenous manure, or with that by the mixed mineral and nitrogenous manure and sawdust, an average annual deficit of 4 to 5 cwts. of first-crop hay, where the cut wheat-straw was employed. The plot with the cut wheat-

straw, like the duplicate unmanured one, was, however, somewhat shaded; and like the latter, though it gave a somewhat deficient first crop, gave at the same time rather more after-grass than the plots most comparable with it. It remains to be seen, therefore, whether the less exhaustion by the first crop hitherto, and the greater return of constituents as manure in the consumption of the second crop, will not, before long, tell upon the amount of produce of the first crop. And how far the inefficiency of both sawdust and cut wheat-straw was due to the slowness of their decomposition, will perhaps be apparent in the course of years.

The mixed mineral manures in conjunction with 400 lbs. per acre, per annum, of ammoniacal salts, gave an annual *produce* of more than 2 tons 19 cwts., and an annual *increase* (over the unmanured) of 1 ton 15⅝ cwts. of strictly Graminaceous hay. The same mineral manures, together with double the above amount of ammoniacal salts, gave even more produce and increase still. The mineral manures and the double supply of ammoniacal salts gave, on the average, 3 tons 3¾ cwts. of annual *produce*, and 1 ton 19¾ cwts. of annual *increase* of Graminaceous hay.

When we bear in mind the fact, that the mixed mineral manure alone scarcely increased the Graminaceous produce at all, it would appear that the increase of such produce, upon the super-addition of the 400 lbs., or of the 800 lbs. of ammoniacal salts, was (so far as its nitrogen was concerned) at any rate mainly due to that which was thus *artificially supplied*. Assuming this to have been the case, it would result that the first increment of 400 lbs. of ammoniacal salts (= 100 lbs. ammonia) yielded an increase of 1 ton 15⅝ cwts. of hay, but that the second increment of the same amount gave a further increase of only 4⅜ cwts. The two together, as above stated, gave 1 ton 19¾ cwts. of increase. As the nitrogenous supply was increased, the effect of a given amount of it was therefore very greatly diminished. Nor is this result to be attributed to a deficiency of mineral constituents where the larger amount of ammoniacal salts was employed. The produce on the addition to the mineral manure of the *smaller* amount of ammoniacal salts, was indeed quite as heavy, if not heavier, than the soil and seasons were suited to mature advantageously. Further evidence on the point will be adduced in a subsequent section of the Report. But it may be here stated in passing, that the crop grown by the larger amount of ammoniacal salts—supplying as it did the enormous quantity of 200 lbs. of ammonia per acre per annum—was so over-luxuriant, as to be much laid, matted together, and dead at the bottom, some time before the bulk was ready for cutting.

It has been already stated that the trials with *nitrate of soda* were not commenced until the last of the three seasons, over

which the other experiments extended. The nitrate too, was sown about a week later than the other manures. The result of this single season's trial with the nitrate was, that a given amount of nitrogen so supplied, did not increase the produce of hay equally with the same amount in the form of ammoniacal salts. Still the influence of artificial nitrogenous supply upon the Grass crop is here again illustrated.

Nitrate of soda, in amount supplying nitrogen equal to about 50 lbs. of ammonia per acre (Plot 6), gave scarcely any increase whatever over the *mean* unmanured produce of the same season.* Double this amount of nitrate of soda (Plot 7), containing nitrogen equal to the ammoniacal salts of Plot 4, gave about $3\frac{3}{4}$ cwts. less increase of hay per acre than the equivalent amount of ammoniacal salts. When the smaller amount of nitrate of soda was used in conjunction with the "mixed mineral manure," the produce amounted to 1 ton $17\frac{3}{4}$ cwts. of hay, or to $11\frac{1}{2}$ cwts. more than when the same amount of nitrate was used alone. Lastly, with the larger amount of nitrate of soda (= in nitrogen to the 400 lbs. of ammoniacal salts), together with the "mixed mineral manure" (Plot 15), there were 2 tons $10\frac{3}{8}$ cwts. of produce instead of 1 ton $11\frac{3}{4}$ cwts. by the same amount of nitrate of soda without the mineral constituents. This increased produce by the nitrate of soda and mineral constituents was, however, considerably less than either the average annual yield, or that of the third season taken alone, by an equal amount of nitrogen in ammoniacal salts, with the mineral manure in addition. So far, however, as the action of the manures applied in such full quantity is cumulative from year to year, it will of course to that extent be illegitimate to draw any strict comparison between the produce of one manure in its third season, and that of another in its first season of application. The character of nitrate of soda as an efficient Grass manure, and as acting, both on this and other crops, by virtue of the nitrogen it contains, is too well established by other experiments—indeed by common experience also—to admit of doubt. It remains to be seen, what will be the comparative effects of a given amount of nitrogen supplied in nitrate of soda and in ammoniacal salts respectively, when the trials have been continued over numerous and various seasons.

Before leaving the results with the nitrate of soda, it should be stated that it had the same effects as the ammoniacal salts, in discouraging the growth of the Leguminous herbage, and in encou-

* It will be remembered, however, that in this third season the duplicate unmanured plot gave an obviously somewhat excessive produce of hay; it having given smaller *mown* crops than the other in the preceding seasons, but more after-feed, and hence the condition of the land on the duplicate plot would be relatively somewhat too high for the third mown crop.

raging that of the Graminaceous plants, or Grasses. The increase of action when the mineral constituents were added to the nitrogen in the form of the nitrate, was, therefore, as in the case of their addition to the ammoniacal salts, *not* to be attributed to their enabling Graminaceous plants to take up more nitrogen *from natural or unaided sources*, but to their supplying, within a limited range of the soil, the mineral constituents requisite for the efficient action upon the collective and assimilative processes of the plants, of the *nitrogen artificially supplied.* It will be shown, on a future occasion, that the *percentage* of nitrogen in the dry substance of the hay, grown both by ammoniacal salts alone, and by nitrate of soda alone, was comparatively very high—in fact, considerably higher than when the mineral manures were also employed, whereby the Graminaceous produce was much increased. So far then as there was an excessive amount of nitrogen, in the form of elaborated nitrogenous vegetable compounds, where the supplied nitrogen was liberal—the mineral constituents in defect—and the growth restricted thereby—it was that there was a relative deficiency in the formation of the non-nitrogenous vegetable substances.

Attention has now been called to the annual amount of hay obtained both without manure, and by the use of certain individual, or classified constituents of manure. In this way, some information has been acquired as to the manurial requirements for the growth of a heavy produce of the crop in question. Let us now examine—what were the effects upon the hay crop of that complex substance—*Farmyard manure?* And, bearing in mind the facts already brought to view, in regard to the action of certain individual manures, let us endeavour to form a judgment as to which of the constituents, or classes of constituents, of farmyard manure, its effects upon the hay crop are mainly, or at any rate characteristically, due.

The annual application of 14 tons of farmyard manure per acre, gave, over the three years, an average annual produce of 2 tons $\frac{1}{4}$ cwt. of hay, = $16\frac{1}{4}$ cwts. per acre per annum more than the unmanured plot. This increase by farmyard manure is greater than that by either the mixed mineral manure alone, or the ammoniacal salts alone; but it is less than half the increase obtained when these two descriptions of manure were used conjointly. This increase of $16\frac{1}{4}$ cwts. of hay per annum, by the use of 14 tons of dung is, it will be seen, little more than 1 cwt. of hay for every ton of the manure employed.

It has been seen that *carbonaceous substance*, whether applied in the form of sawdust or of cut wheat-straw, had little or no effect upon the hay crop. It is probable that the carbonaceous substance of the dung would yield up its carbon in the form of

carbonic acid, or of other products of decomposition, more readily than that of either of the substances just mentioned. But the farmyard manure contained, besides carbonaceous substance, a large amount of both mineral constituents, and of ammonia, or nitrogen in some form. It has been seen, too, that these latter substances, when used without carbonaceous matter, gave greatly increased crops of hay. Under these circumstances, we can hardly hesitate to attribute the main effects of the farmyard manure upon the hay crop, rather to the conjoint action of its mineral and nitrogenous constituents than to its enormous bulk of carbonaceous substance.

That the *mineral* constituents of the dung had their share of effect, would appear from the fact, that the Leguminous herbage was moderately luxuriant on the dung plot, and that those of the Grasses were the most developed which were increased in their proportion to the rest by the artificial mineral manures. And again, that the *nitrogen* also of the dung was effective, may be judged, not only from the general development of the Graminaceous plants under its use, but from the fact of a like fullness in the proportion of the Grasses *in flowering and seeding stem*, as where ammoniacal salts were employed in conjunction with the mixed mineral manure. It would appear, however, that a much less proportion of the whole nitrogen supplied to the land was active, when it was provided in the form of farmyard manure, than when in that of ammoniacal salts. There would, in fact, be considerably more of nitrogen applied per acre in the 14 tons of farmyard manure, than in the 400 lbs. of the mixed ammoniacal salts. Nevertheless, the encouragement of the Leguminous plants was much greater, and that of the Graminaceous ones much less, where the farmyard manure was employed, than where the 400 lbs of ammoniacal salts, together with the mixed mineral manure, were used.

That the less produce by the farmyard manure, than by the mixed mineral manure and 400 lbs. of ammoniacal salts, was due to a deficiency of *available* nitrogen, notwithstanding the large actual *amount* of it in the dung, would appear from the fact, that on the employment of 200 lbs. of ammoniacal salts *in addition* to the farmyard manure (Plot 17), there was a further average annual increase of $8\frac{3}{8}$ cwts. of hay per acre. Still, even with this addition, there was about $\frac{1}{2}$ a ton less of hay annually than where the "mixed mineral manure" and the 400 lbs. of ammoniacal salts were applied.

The evidence regarding the action of the farmyard manure goes to show, that, though it is doubtless a very complete and important restorer of both the mineral constituents and the nitrogen required to repair the exhaustion of this most greedy

crop, yet, the amount of these constituents supplied by its means is proportionally much less active within a given time than that provided in the artificial combinations. As, however, permanent meadow-land, especially when attached to an arable farm, does not, as practice goes, so much as a matter of course, come in for a due periodic supply of farmyard manure as does the land under rotation, it becomes far more necessary in its case to bestow special consideration that the mineral constituents be not exhausted, than in that of rotation crops under ordinary good management. In fact, the grass-land of the arable farm is but too frequently looked upon as the legitimate sphere for robbery for the other crops. Indeed, considering the nature of the exhaustion of permanent grass-land generally, when mown for hay, and at the same time bearing in mind the character of the artificial manures, which are, in point of economy, at the command of the farmer, it would seem that the *permanent* condition of such land should be kept up by farmyard manure, stable dung, town manures, and the like, and the *active growth* aided, year by year, by the so-called artificial, nitrogenous—or, better still, nitrogenous and phosphatic—manures. Where hay is grown for the supply of a neighbouring town, the (in the above sense) permanent condition of the land is very generally maintained by town manures of some kind brought by the return carriage. But where hay is grown on an arable farm, and is mown for consumption by the stock (or, still worse, for sale), the return is but too often by no means so complete. The question of keeping up the fertility of grass-land by sewage, or other irrigation, is one of course of entirely separate consideration from that now before the reader.

Before giving a summary enumeration of the results and conclusions thus far indicated, it will be well to direct attention to the relative, and, as far as they can be estimated, the *actual* amounts of after-grass yielded, on the differently manured plots.

In Table II. are given :—

In the 1st Division—the actual number of sheep that were put upon each plot of after-grass, and the actual number of days they were fed upon it, in each of the three seasons of the experiments;

In the 2nd Division—the number of sheep calculated to be kept per acre, on each plot for one week, in each of the individual seasons, and on the average of the three seasons; and

In the last column of the Table—the estimated average annual amount of hay per acre, to which the after-grass consumed would be equivalent, reckoning the sheep to eat grass equal in amount to 16 lbs. of hay per head, per week.

Calculating the after-grass into its assumed equivalent of hay, as

EXPERIMENTS with DIFFERENT MANURES on PERMANENT MEADOW LAND.

TABLE II.—SHOWING the Number of SHEEP fed by the AFTER-GRASS, and the quantity of HAY to which it is estimated to be equivalent.

Plot, Nos.	MANURES (Per Acre, per Annum).	Area of Plots.	ACTUAL PARTICULARS OF THE FEEDING. 1856. Sheep put on, Oct. 10. Number of Sheep.	1856. Number of Days Feeding.	1857. Sheep put on, Sept. 23. Number of Sheep.	1857. Number of Days Feeding.	1858. Sheep put on, Oct. 18. Number of Sheep.	1858. Number of Days Feeding.	CALCULATED RESULTS. Number of Sheep kept for One Week per Acre. 1856.	1857.	1858.	Average Annual.	Estimated Average Amount of Hay per Acre, per Ann. in the After-grass.* lbs.
	SERIES 1.—Without Direct Mineral Manure.												
		Acre.											
1	Unmanured	¼	10	13	8	13	10	12	37·1	29·7	34·3	33·7	539
2	Unmanured (duplicate plot)	¼	10	17	10	13	†9½	12	48·7	34·3	32·6	38·5	617
	Mean, or Standard Unmanured		10	15	9	13	†9¾	12	42·9	32·0	33·4	36·1	578
3	2000 lbs. Sawdust	¼	20	13	16	13	16	12	37·1	29·7	27·4	31·4	503
4	200 lbs. each, Sulphate and Muriate Ammonia	¼	20	14	20	13	20	12	40·0	37·1	34·3	37·1	594
5	200 lbs. each, Sulphate and Muriate Ammonia, and 2000 lbs. Sawdust	¼	20	14	20	13	20	12	40·0	37·1	34·3	37·1	594
6	275 lbs. Nitrate of Soda	1/6	..	..	..	..	60	1	..	..	51·4	51·4	823
7	550 lbs. Nitrate of Soda	1/6	..	..	..	..	60	1	..	..	51·4	51·4	823
	SERIES 2.—With Direct Mineral Manure.												
8	"Mixed Mineral Manure"	¼	20	14	25	13	25	12	40·0	46·4	42·9	43·1	689
9	"Mixed Mineral Manure," and 2000 lbs. Sawdust	¼	20	14	25	13	25	12	40·0	46·4	42·9	43·1	689
10	"Mixed Mineral Manure," and 200 lbs. each, Sulphate and Muriate Ammonia	¼	30	11	30	12	30	12	47·1	51·4	51·4	50·0	800
11	"Mixed Mineral Manure," 200 lbs. each, Sulphate and Muriate Ammonia, and 2000 lbs. Sawdust	¼	30	11	30	12	30	12	47·1	51·4	51·4	50·0	800
12	"Mixed Mineral Manure," 200 lbs. each, Sulphate and Muriate Ammonia, and 2000 lbs. Cut Wheat Straw	¼	30	17	30	13	30	12	72·8	51·4	51·4	58·5	937
13	"Mixed Mineral Manure," and 400 lbs. each, Sulphate and Muriate Ammonia	¼	40	11	40	12	40	12	62·9	68·6	68·6	66·7	1067
14	"Mixed Mineral Manure," and 275 lbs. Nitrate of Soda	1/6	..	..	..	..	60	1	..	..	51·4	51·4	823
15	"Mixed Mineral Manure," and 550 lbs Nitrate of Soda	1/6	..	..	..	..	60	1	..	..	51·4	51·4	823
	SERIES 3.—With Farmyard Manure.												
16	14 Tons Farmyard Manure	¼	10	13	12	13	11	12	37·1	44·6	37·8	39·8	638
17	14 Tons Farmyard Manure, and 100 lbs. each, Sulphate and Muriate Ammonia	¼	10	13	12	13	11	12	37·1	44·6	37·8	39·8	638

* The calculation is made on the assumption that each Sheep would eat grass = 16 lbs. of Hay per week.
† One Sheep was taken from this plot to be killed when it had been only half the period feeding.

as above described, the result is, of course, only an approximation to the truth. Looked upon as such, it is not without its value and interest. The so-estimated amounts of after-feed on the respective plots show, as compared one with another, relations very coincident, in general direction, with those indicated by the mown first-crops of hay.

It has already been noticed that the produce of first-crop hay on Plot 2 (the duplicate unmanured plot) was less in the first two seasons, and more in the third, than on Plot 1, the other unmanured one. Table II. shows, on the other hand, that there was rather more after-feed in the two first seasons on the duplicate unmanured plot than on the other. Taking the mean of the two plots, the unmanured land shows an average annual yield of after-grass = 578 lbs. of hay. The sawdusted plot, as in the first crop, so again in the second, gives rather less produce than the unmanured one. The ammoniacal salts alone gave rather more after-feed than the unmanured plot; and the ammoniacal salts and sawdust gave the same amount as the ammoniacal salts alone. The Plot with the "mixed mineral manure" alone, with its luxuriant Leguminous herbage, gave more after-feed than the one with ammoniacal salts alone. The addition of the sawdust to the "mixed mineral manure" gave no further increase. The Plot with both the "mixed mineral manure" and the 400 lbs. of ammoniacal salts, as in the first crop, so now in the second, gave more produce than either of the plots where the respective manures were used separately. The addition of sawdust to the mixture of the two manures gave no further increase. The addition of cut wheat-straw, instead of sawdust, showed some advantage in the second crop, the produce in the first crop being somewhat deficient. The combination of the "mixed mineral manure," and the double amount (= 800 lbs. per acre) of ammoniacal salts, gave the largest amount of first-crop hay, and now again the largest amount of after-grass, of any manure in the series.

The nitrate of soda, which was used only in the third season, and then yielded less of first-crop hay than an amount of ammoniacal salts equal to it in contents of nitrogen, appears, according to the figures in the Table, to have given, on the other hand, a larger amount of after-grass. As, however, a large and equal number of sheep was put upon each of the nitrate plots, and *for one day only*, not even the relative amounts, still less the actual quantities recorded as estimated second-crop hay, can be much relied upon in these cases of experiment with the nitrate.

The farmyard manure plots gave of second crop, as they did of first, a produce intermediate between that without manure, and that by the "mixed mineral manure" and 400 lbs. of ammoniacal salts.

Were these estimated amounts of hay in the second crop of the respective plots to be added to those actually removed in the first crop, the *comparative* action of the different manures as it would be then represented, would not appear to differ in any material point from that indicated by the amounts of hay actually taken off in the first crop. Independently of this, however, by far the larger proportion of both the mineral constituents and the nitrogen of the second crop would, as before stated, be returned to the land by the sheep feeding upon it. It would, therefore, obviously be a further deviation from the true representation of the actual facts, to take into account the estimated second crop as a part of the removed produce of the manures employed, than to omit it from the calculation altogether. These estimated amounts of second crop, varying as they do in the proportion of from 1 to 2, according to the manure employed, are, nevertheless, interesting of themselves, as showing great differences in vegetative activity after removal of the first crops, depending, of course, on the varying character and amount of the residual or unused manure. They are, moreover, useful aids in forming a judgment respecting the comparative cumulative effects, from year to year, of the different manures. But when, in a subsequent Part of this Report, we come to consider the debtor and creditor account of certain constituents on the several plots—the relation of the amounts removed in the produce to those supplied in manure—we shall assume the amounts taken off in the increase of the first crop only, as the most nearly representing the gain due to the supply in the manure employed.

It is proposed, on a future occasion, to show the acreage amounts of certain constituents removed in the produce from the different plots, and the relation of these in the increase, to those supplied in the manures—to consider in some detail the varying description of the herbage according to the manure employed—and to show the consequent variations in the chemical composition of the complex gross produce, or *hay*. In the mean time, founded upon the evidence thus far recorded, relating to the amount per acre, and the general character, of the hay obtained by the different manures, the following general results and conclusions may be enumerated:—

That the effect of a mixed, but purely *mineral manure*, upon the complex herbage of permanent meadow land, was chiefly to develop the growth of the *Leguminous* plants it contained; and scarcely at all to increase the produce of the *Graminaceous* plants, or commonly called *Natural Grasses*.

That the action of purely *nitrogenous manures*, upon the per-

manent meadow, was to discourage the growth of the *Leguminous* herbage, and to increase the produce of the *Graminaceous* hay.

That by the *combination of both nitrogenous and proper mineral manures*, the produce of *Graminaceous* hay was very much increased. In the particular soil and seasons in question, the increase obtained by the combination was far beyond the sum of the increase yielded by the two descriptions of manure, when each of them was used separately.

That *farmyard manure* gave a considerable increase of chiefly *Graminaceous* hay. In the soil and seasons in question, however, the artificial combination of nitrogenous and mixed mineral manure yielded a very much larger increase than an annual dressing of 14 tons of farmyard manure.

That peculiarly *carbonaceous manures* had little or no beneficial effect on the amount of produce of the hay. That the little effect (if any) which the carbonaceous manures did exhibit, seemed to be favoured by admixture with mineral manures; and then (as when the mineral manures were used alone) it appeared to be the Leguminous, rather than the Graminaceous herbage, that was encouraged.

That the beneficial action of *farmyard manure* upon the Grass crop is to be attributed chiefly to its *mineral and nitrogenous constituents*, and comparatively little to its large amount of carbonaceous substance.

That the large increase of produce obtained by the *combination of nitrogenous and mixed mineral manure*, being almost entirely *Graminaceous*, the mineral manures, when in this combination, did not act as when used alone, in developing the highly nitrogenous *Leguminous* herbage. The great increase in the produce of hay obtained by the conjunction of the mineral with the nitrogenous manure is to be attributed to the supply, within a limited range of the soil, of a sufficient amount of the necessary mineral constituents, to enable the *Graminaceous* plants to turn to the account of growth, *the nitrogen at the same time artificially supplied.*

The general result is, that the Leguminous plants in the *meadow*, like those grown in our *arable fields*, were much increased in growth, and assimilated more nitrogen from unaided sources over a given area, when they were liberally supplied with certain *mineral*, or *primarily soil-constituents.* At the same time, notwithstanding the high (both percentage and acreage) yield of nitrogen in Leguminous produce generally, the increased growth of the *Leguminous herbage of the meadow* was not favoured by the direct supply of nitrogenous manures—a result which is again very similar to that obtained with the *Leguminous crops of our rotations.* On the other hand, the Graminaceous *hay*

plants, like the Graminaceous *corn-crops of our rotations*, assimilated but little more nitrogen, from natural sources, under the influence of liberal supplies of purely mineral manure; they gave a largely increased growth, only when there was an artificial supply of *available nitrogen within the soil;* and when this was provided, the direct supply of mineral constituents was essential to its full effects.

The more practical conclusions may be very shortly stated. In order that the more temporary, or more rapidly acting means of increasing the produce of meadow land, may have their full effect, the more permanent means of amelioration that may be required—such as draining, marling, liming, and the like—must not be neglected. The application of bones is not recommended for general adoption. They appear to be chiefly adapted to the exhausted pastures of certain localities, and not to be generally applicable to meadow land which is mown for hay. The hay crop is a great exhauster of the mineral constituents of the soil; and these, owing to the high price of salts of potash, cannot, with profit, be fully restored in artificial manures. The return of the mineral constituents is better accomplished by means of farmyard manure, stable dung, night soil, and the like; which, at the same time, bring on to the land a more or less considerable quantity of available nitrogen. The best artificial manures for grass-land, are, Peruvian guano, which is rich in phosphates as well as nitrogen; and nitrate of soda, and sulphate of ammonia, which are rich in nitrogen, but contain, of course, no phosphates. Peruvian guano, when used alone, may be employed at the rate of from 1½ to 2½ cwts. per acre; nitrate of soda alone, or sulphate (or muriate) of ammonia, at the rate of 1½ to 2 cwts. per acre. The salts of ammonia are, however, relatively too expensive to be employed largely with profit; and both ammoniacal salts and nitrate of soda are more advantageously used in combination with guano. A very generally useful top-dressing for the hay crop may be made of 3 parts Peruvian guano, 1 part nitrate of soda, and 1 part sulphate of ammonia. Of this mixture, 2 to 2½ cwts. per acre may be employed. With this applied annually, and the application of 10 or 12 tons per acre of poor rotten dung once every four or five years, a good crop of hay may be taken off every year, without injury to the land. The best time of sowing the "artificial" manures is generally in January; and it should at any rate be seldom postponed beyond February.

[To be continued.]

XXVI.—*Mode of Cultivation and kind of Manure employed for the Turnips and Carrots which received Prizes at the Birmingham Show, Dec.* 1858.

Top Farm, Keele, Staffordshire, 10*th Dec.* 1858.

Sir,—In accordance with your request, I beg to inform you that the land on which the turnips were grown that won the prizes at the Birmingham Cattle Show, 1858, is a clay soil of a cold and heavy nature, which dry weather suits much better than wet. In 1857 the land had wheat upon it, and after the wheat crop was got in I ploughed up the stubble with a 12-inch furrow, and allowed it to lie in that state until March, 1858, in order to give it a chance of being thoroughly pulverized. I cross-ploughed the land towards the end of May, and in the early part of June I broke the furrows down and cleaned it; I then ridged it in the usual way and manured with 20 tons of farmyard manure, 2 cwt. guano, and 2 cwt. superphosphate per acre. The seed I used is bronze-top swede, supplied by Messrs. Burgess and Kent, of Penkhull. The season was dry while the plants were young, and they appeared to suffer from it; but as the season advanced I had the gratification of observing them daily improving, and becoming eventually one of the best crops I have ever seen.

I had seventeen acres of them, and there was very little difference in the quality of the whole crop. I sowed the guano and superphosphate on the farmyard manure in the ridges, and I have proved by experience that it is a much better plan than sowing artificial manures broadcast. I pursued the same course with the mangold-wurzel, but on a blue clay and a much worse soil, and not with equal success.

I am, &c.,

Charles Holland.

H. S. Thompson, Esq.

Osberton, 9*th Dec.* 1858.

Sir,—I am desired by Mr. Foljambe to send you, in accordance with your request, the following particulars of the mode of management and the kind of manure used for the carrots that gained the first prize at the late Birmingham show. The land is a light sandy soil. Wheat in 1857; afterwards cleared of stubble and weeds; in November ploughed 10 inches deep, and left for winter frosts. In March, 1858, the land was dragged, harrowed, and rolled until quite fine; the second week in April put 15 cart loads of good rotten farmyard manure on, then ploughed it in with one of Howard's skim ploughs, 10 inches deep, followed by a subsoil

plough, 7 inches deeper than the first; afterwards harrowed and ridged up 24 inches apart, then passed a light roll over the ridges, followed by a common turnip-drill, to make a mark for the seed. Five lbs. per acre of white Belgian and red Altrincham carrot-seed, bought of Mr. Sanderson, of Worksop, was then sown by hand (three men sow two acres per day) and covered with the back of a rake. When the plants came up commenced horse-hoeing to destroy the weeds whilst young, and when the carrots were about 4 inches high they were struck across with a 6-inch hoe and left for 14 days, and then singled out, taking care to leave the strongest plants; afterwards kept clean by repeated horse-hoeing. The time of getting them up was the first or second week in November. I have tried many other methods of growing carrots, but never succeeded so well with any other as with the one described above, which I have practised for the last 14 years. The calculated weight of the crop on the 4 acres from which the Birmingham prize carrots were taken was 28 tons per acre. I did not send the largest roots to the Show, as they were rather rough. Some of the carrots girthed nearly 20 inches, and weighed between 12 and 13 lbs. each.

I am, &c.,

R. Woods, Farm Bailiff.

To H. S. Thompson, Esq.

END OF VOL. XIX.

LONDON: PRINTED BY W. CLOWES AND SONS, STAMFORD STREET, AND CHARING CROSS.

Royal Agricultural Society of England.

1858—1859.

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MEMORANDA.

ADDRESS OF LETTERS.—The Society's office being situated in the new 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, on Friday, December 10, at Eleven o'clock, A.M.

GENERAL MEETING in London, on Monday, May 23, 1859, at Twelve o'clock.

COUNTRY MEETING at Warwick, in 1859.

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.

WEEKLY COUNCIL (for practical communications), at 12 o'clock on all Wednesdays in February, March, April, May, June, and July, excepting the first Wednesday in each of those months, and during adjournment: open to all Members of the Society, who are particularly invited by the Council to avail themselves of this privilege.

ADJOURNMENTS.—The Council adjourn over Easter, Passion, and Whitsun 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.

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 present Appendix, p. xii.)

CHEMICAL ANALYSIS.—The privileges of Chemical Analysis enjoyed by Members of the Society will be found stated in the present Appendix, p. xi.

LOCAL CHEQUES.—Members are particularly requested not to forward Country Cheques for payment in London; but London Cheques, or Post-office Orders (payable to "James Hudson"), in lieu of them. All Cheques are required to bear upon them a penny draft or receipt stamp, which must be cancelled in each case by the initials of the drawer. They may also conveniently transmit their Subscriptions to the Society, by requesting their Country Bankers to pay (through their London Agents) the amount at the Society's Office (No. 12, Hanover Square, London), between the hours of ten and four, when official receipts, signed by the Secretary, will be given for such payments.

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.

PACKETS BY POST.—Packets not exceeding two feet in length, width, or depth, consisting of written or printed matter (but not containing letters sealed or open), if sent without envelopes, or enclosed in envelopes open at each end, may be forwarded by the inland post, if stamped, at the following rates:—

For a packet not exceeding	4	ounces	(or quarter of a pound) . . .	1 penny.
,, ,, ,,	8	,,	(or half a pound)	2 pence.
,, ,, ,,	16	,,	(or one pound)	4 ,,
,, ,, ,,	24	,,	(or one pound and a half) . .	6 ,,
,, ,, ,,	32	,,	(or two pounds)	8 ,,

[And so on in the proportion of 8 ounces for each additional 2*d*.]

*** 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 and Veterinary Privileges, and of other printed papers connected with special departments of the Society's business.

Royal Agricultural Society of England.

GENERAL MEETING,

12, Hanover Square, Saturday, May 22, 1858.

REPORT OF THE COUNCIL.

The Society consists at the present time of—

81 Life Governors,
133 Annual Governors,
904 Life Members,
4010 Annual Members, and
18 Honorary Members,

making a total of 5146 names on the list.

The Council have elected Mr. Thompson, of Kirby Hall, a Trustee of the Society, in the place of the late Earl Spencer; and His Grace the Duke of Rutland a Vice-President, in that of the late Lord Braybrooke. They have also elected the Hon. Colonel Hood, Mr. Humberston (Mayor of Chester), Mr. Huskinson, and Mr. Hutton, General Members of the Council, to supply the vacancies created respectively by the transfer of Viscount Eversley to the class of Vice-Presidents, and Mr. Thompson to the class of Trustees, and by the decease of Mr. Simpson and Mr. Stephen Mills.

The funded capital of the Society stands at 9264*l.* 8*s.* 11*d.* Stock in the New Three per Cents.

The Chairman and Vice-Chairmen of the Journal Committee have announced to the Council that their respective personal engagements will not allow them to devote as large a share of attention as they have hitherto done to the editing of the Journal; but they have subsequently acceded to the request of the Council that they should continue their services until some permanent

arrangement shall have been made. The Council, in order to diminish the amount of the mechanical details connected with their labours, have placed at their disposal a grant not to exceed 300*l.* annually, for the purpose of engaging such literary aid as they may find requisite for the more convenient editorship of the Journal.

The excellent paper on Horse-Shoeing by Mr. Miles, of Dixfield, near Exeter, published in the last part of the Journal, has been reprinted in a cheap form for extensive distribution, and already upwards of a thousand copies have been sold.

The Governors of the Royal Veterinary College have presented their annual report of the progress made at that institution in the application of the veterinary art, and the treatment of the diseases of cattle, sheep, and pigs. They state that the number of pupils qualified to act as practitioners in carrying out these objects of the Society continues to increase; but they regret that the members of the Society do not avail themselves more extensively of their privilege of sending diseased animals, in a live or dead state, to the College, thus furnishing means for the acquisition of a larger amount of practical experience by the Professor of Cattle Pathology and his pupils.

The Council have appointed Professor Voelcker, of the Royal Agricultural College at Cirencester, to be the Consulting-Chemist of the Society; and he has already delivered before the members his inaugural lecture on Agricultural Chemistry in its Relation to the Cultivation of Root-crops. They have also made arrangements with Professor Henfrey, of King's College, for the delivery of a lecture on Vegetable Physiology, on Wednesday next, the 26th of May. This lecture, as in the case of Professor Voelcker's, will be taken down in its full extent by a short-hand writer, and immediately made public. The Council hope that this early publication of the lectures, by at once placing before the agricultural community any facts of an important practical character, will be found to meet the wishes of the members.

The Chester Meeting promises, from its variety and extent, to be of an interesting character. The Council have made special arrangements for the trial of steam-cultivators, by which their relative merits will be tested during the whole of the week

previous to that of the meeting; and they have decided that machinery in motion shall be exhibited on the same plan as last year. The Council have adopted the recommendation of the Local Committee, that a dinner should take place in the Music Hall at Chester, capable of accommodating 500 guests. They have decided that, for the future, when a dinner is proposed at the Country Meeting of the Society, the whole arrangements shall be made and the expenses borne by the Local Committee, the Council reserving to themselves the right of appointing the Chairman, and of preparing the list of toasts; and that, after the present year, the show of poultry, as a portion of the Society's exhibition, shall be discontinued.

The Council have appointed a Committee to report upon the propriety of renewing or discontinuing, after the current year, the triennial arrangement for the trial of implements, adopted for the Chelmsford, Salisbury, and Chester meetings.

The Council have selected Warwick as the place of the Country Meeting for the year 1859; and have decided that after the year 1860 they will be prepared to hold a Metropolitan Meeting, should circumstances be found favourable in the mean time for the adoption of such an arrangement.

By order of the Council,

James Hudson, Secretary.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

Half-Yearly Account from the 1st of July to the 31st of December, 1857.

Receipts during the half-year.	£.	s.	d.
Balance in the hands of the Bankers, July 1, 1857	989	8	10
Petty Cash Balance in the hands of the Secretary, July 1, 1857	16	6	7
Dividends on Stock	134	18	4
Governors' Life-Compositions	90	0	0
Governors' Annual Subscriptions	70	0	0
Members' Life-Compositions	168	0	0
Members' Annual Subscriptions	506	1	0
Journal Receipts	139	5	3
Country Meeting Receipts:—			
Salisbury	2805	10	4
	£4919	10	4

Payments during the half-year.	£.	s.	d.
Permanent Charges	178	12	6
Taxes and Rates	17	2	6
Establishment Charges	450	1	11
Postage and Carriage	18	15	10
Journal Payments	171	10	2
Veterinary Grant	100	0	0
Veterinary Professors' Expenses abroad	117	2	6
Chemical Grant	150	0	0
Country Meeting Payments:—			
Salisbury	3366	8	7
Sundry items of Petty Cash	3	12	11
Balance in the hands of the Bankers, Dec. 31, 1857	331	15	11
Petty Cash Balance in the hands of the Secretary, Dec. 31, 1857	14	7	6
	£4919	10	4

(Signed) THOMAS RAYMOND BARKER, *Chairman*,
C. B. CHALLONER,
HENRY WILSON,
} *Finance Committee.*

Examined, audited, and found correct, this 21st day of May, 1858.

(Signed) GEORGE I. RAYMOND BARKER,
WILLIAM ASTBURY,
JOSEPH DRUCE.
} *Auditors on the part of the Society.*

Essays and Reports.—PRIZES FOR 1859.—All Prizes of the Royal Agricultural Society of England are open to general competition. Competitors will be expected to consider and discuss the heads enumerated.

I. MICROSCOPIC INVESTIGATION.

FIFTY SOVEREIGNS will be given for the best Report on the Results of Microscopic Observation applied to the Vegetable Physiology of Agriculture.

It is not thought desirable to confine the observer too strictly to any particular line of research, the only necessary limitation being, that the plants to be examined and reported upon shall be selected from those commonly cultivated; such as the *cereals*, or those usually known under the names of *pulse*, *root*, and *fodder* crops. The structural formation of these plants—their ordinary vital processes—modifications of the above induced by climatic influences or the application of manure—morbid changes of their tissues consequent upon the attacks of insects or disease,—would all prove extensive and interesting fields of inquiry; and it must be left to the writers themselves to select those particular branches of the subject on which they are able to supply the greatest amount of original information.

II. THE CHANNEL ISLANDS.

TWENTY-FIVE SOVEREIGNS will be given for the best Report on the Agriculture of the Islands of Jersey, Guernsey, Alderney, and Sark.

The leading physical features of each should be given: character of the Soil; its Agricultural Tenures; size of Farms, as well as various modes of cultivation, describing any peculiarities of local practice; Implements; Live Stock; Dairy Management; Imports and Exports of Farming Produce; Population; reference to former Agricultural Surveys, or notices of a like character; Agricultural changes in progress, or needed.

III. STEAM CULTIVATION.

TWENTY-FIVE SOVEREIGNS will be given for the best Account of the application of Steam Power to the cultivation of the Land.

In addition to a general description of the methods now in use, and of such success as has been attained, competitors will be required to give a detailed account of one or more cases where steam power has been employed in the ordinary cultivation of a farm.

IV. TILLAGE A SUBSTITUTE FOR MANURE.

Twenty Sovereigns will be given for the best Essay on the extent to which tillage operations act as a substitute for manure.

V. MODIFICATIONS OF FOUR-COURSE SYSTEM.

Twenty Sovereigns will be given for the best Report on the Modifications of the Four-Course Rotation which modern improvements have rendered advisable.

Competitors will be required to describe such deviations from the four-course system as have come within their own experience or observation, pointing out the causes of each change and the advantages obtained thereby. Suggestions of new and untried rotations must be carefully distinguished from the results of past experience.

VI. VARIETIES OF CEREALS FOR HIGH FARMING.

Twenty Sovereigns will be given for the best Report on the varieties of Wheat, Barley, and Oats most suitable for highly-farmed Land.

Varieties of cereals are frequently confined to very limited districts, and even when they extend over a wider area are generally known by mere local names. Candidates will therefore be expected to send small samples, of six heads, of each of the varieties of cereals recommended, to accompany their respective reports. Care must be taken to tie the small samples together in one bundle, and attach to it a motto paper corresponding to the one enclosed with the report.

VII. FAILURE OF TURNIP CROP.

Twenty Sovereigns will be given for the best Report on the causes of the increasing difficulties of Turnip Cultivation, and the remedies.

In many turnip-growing districts this crop is found to be less hardy than heretofore, and more liable to the attacks of various diseases. Competitors will be expected to discuss the question whether this is due to the too frequent repetition of this crop, or to any differences in the mode of cultivation or the kinds of manures employed, and to support their opinions as much as possible by facts in preference to abstract reasoning.

VIII. COMPARATIVE COST OF CATTLE FOOD AND MANURE.

Twenty Sovereigns will be given for the best Report on the Comparative Cost of bringing Land into high condition by the purchase of Cattle Food, or the purchase of Manure.

Whatever experience is described in illustration of this subject must be accompanied by full details of price and quantity, both of the manures employed and the crops produced on the one hand, and on the other of the cattle food purchased and consumed, the meat and manure produced, and the field produce obtained by the application of the latter.

IX. ANY OTHER AGRICULTURAL SUBJECT.

Ten Sovereigns will be given for the best Essay on any other agricultural subject.

Reports or Essays competing for the Prizes must be sent to the Secretary of the Society, at 12, *Hanover Square, London, on or befor March* 1, 1859. *Contributors of Papers are requested to retain Copie of their Communications, as the Society cannot be responsible for their return.*

RULES OF COMPETITION FOR PRIZE ESSAYS.

1. All information contained in Prize Essays shall be founded on experience or observation, and not on simple reference to books or other sources. Competitors are requested to use foolscap or large letter paper, and not to write on both sides of the leaf.

2. Drawings, specimens, or models, drawn or constructed to a stated scale, shall accompany writings requiring them.

3. All competitors shall enclose their names and addresses in a sealed cover, on which only their motto, the subject of their Essay, and the number of that subject in the Prize List of the Society, shall be written.*

4. 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.

5. The Chairman of the Journal Committee shall alone be empowered to open the motto-paper of any Essay not obtaining the Prize, that 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 Essay at the disposal of the Journal Committee.

6. 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 the other Essays will be returned on the application of the writers; but the Society do not make themselves responsible for their loss.

7. The Society are not bound to award a prize unless they consider one of the Essays deserving of it.

8. In all reports of experiments the expenses shall be accurately detailed.

9. The imperial weights and measures only are those by which calculations are to be made.

10. No prize shall be given for any Essay which has been already in print.

11. Prizes may be taken in money or plate, at the option of the successful candidate.

12. All Essays must be addressed to the Secretary, at the house of the Society.

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* Competitors are requested to write their motto on the enclosed paper on which their names are written, as well as on the outside of the envelope.

Members' Privileges of Chemical Analysis.

The Council have fixed the following rates of Charge for Analyses to be made by the Consulting Chemist for 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 Analyses made for Persons commercially engaged in the Manufacture of any Substance for Sale.*

The Address of Professor Voelcker, the Consulting Chemist of the Society, is Cirencester, Gloucestershire, to which he requests that all letters and parcels (postage and carriage paid) should be directed: for the convenience, however, of persons residing in London, parcels sent to the Society's Office, No. 12, Hanover Square, will be forwarded to Cirencester once or twice a week.

By Order of the Council,

JAMES HUDSON, Secretary.

Members' Veterinary Privileges.

I.—Veterinary Inspection.

No. 1. Any member of the Society who may desire a competent professional opinion and special advice in cases of extensive or destructive disease among his stock, and will address himself by letter to the Secretary, will, by return of post, receive a printed list of queries, to be filled up and returned to him immediately. On the receipt of such returned list, the Secretary will convene the Veterinary Committee forthwith (any two Members of which, with the assistance of the Secretary, will be competent to act); and such Committee will decide on the necessity of despatching Professor Simonds, the Society's Veterinary Inspector, to the spot where disease is said to prevail.

No. 2. The remuneration of such Inspector will be 2*l.* 2*s.* each day as a professional fee, and 1*l.* 1*s.* each day on account of personal expenses; and he will also be allowed to charge the cost of travelling to and from the localities where his services may have been thus required. The fees will be paid by the Society, but the travelling expenses will be a charge against the applicant for professional aid. This charge may, however, be reduced or remitted altogether at the discretion of the Council, on such step being recommended to them under peculiar circumstances by the Veterinary Committee.

No. 3. The Inspector, on his return from visiting the diseased stock, shall 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 may 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.—Investigations, Lectures, and Reports.

No. 1. All Members of the Society have the privilege of sending cattle, sheep, and pigs to the Royal Veterinary College, on the same terms as if they were Members of the College.

No. 2. The College have 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 from time to time 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, or at its Annual Meetings in the country, as the Council may decide.

No. 4. The Royal Veterinary College will from time to time furnish to the Council of the Society a detailed Report of the cases of cattle, sheep, and pigs treated in the College.

By Order of the Council,

JAMES HUDSON, Secretary.

Royal Agricultural Society of England.

1858—1859.

MEMORANDA.

ADDRESS OF LETTERS.—The Society's office being situated in the new 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, on Monday, May 23, 1859, at Twelve o'clock.

COUNTRY MEETING at Warwick, in the week commencing Monday, the 11th of July, 1859.

GENERAL MEETING in London, on Friday, December 9, at Eleven o'clock, A.M.

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.

WEEKLY COUNCIL (for practical communications), at 12 o'clock on all Wednesdays in February, March, April, May, June, and July, excepting the first Wednesday in each of those months, and during adjournment: open to all Members of the Society, who are particularly invited by the Council to avail themselves of this privilege.

ADJOURNMENTS.—The Council adjourn over Easter, Passion, and Whitsun 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.

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 present Appendix, p. xii.)

CHEMICAL ANALYSIS.—The privileges of Chemical Analysis enjoyed by Members of the Society will be found stated in the Appendix of the present volume, p. xi.

LOCAL CHEQUES.—Members are particularly requested not to forward Country Cheques for payment in London; but London Cheques, or Post-office Orders (payable to "James Hudson"), in lieu of them. All Cheques are required to bear upon them a penny draft or receipt stamp, which must be cancelled in each case by the initials of the drawer. They may also conveniently transmit their Subscriptions to the Society, by requesting their Country Bankers to pay (through their London Agents) the amount at the Society's Office (No. 12, Hanover Square, London), between the hours of ten and four, when official receipts, signed by the Secretary, will be given for such payments.

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.

PACKETS BY POST.—Packets not exceeding two feet in length, width, or depth, consisting of written or printed matter (but not containing letters sealed or open), if sent without envelopes, or enclosed in envelopes open at each end, may be forwarded by the inland post, if stamped, at the following rates:—

For a packet not exceeding	4 ounces	(or quarter of a pound)	1 penny.
,, ,, ,,	8 ,,	(or half a pound)	2 pence.
,, ,, ,,	16 ,,	(or one pound)	4 ,,
,, ,, ,,	24 ,,	(or one pound and a half)	6 ,,
,, ,, ,,	32 ,,	(or two pounds)	8 ,,

[And so on in the proportion of 8 ounces for each additional 2*d.*]

*** 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 and Veterinary Privileges, and of other printed papers connected with special departments of the Society's business.

Royal Agricultural Society of England.

GENERAL MEETING,

12, Hanover Square, Friday, December 10, 1858.

REPORT OF THE COUNCIL.

The Society consists at the present time of—

79 Life Governors,
134 Annual Governors,
916 Life Members,
4076 Annual Members, and
18 Honorary Members,

making a total of 5223 Members, or an increase of 77 names on the list since the last half-yearly meeting. The Council have filled up the vacancy in their body, occasioned by the decease of Mr. Paine, of Farnham, by the election of Mr. Thomas, of Lidlington.

The funded property of the Society in the name of the trustees has been raised by further investment to the amount of 10,000*l.* stock in the New Three-per-cents.

Mr. Dyke Acland and Mr. Wren Hoskyns having found that their own more immediately personal engagements would not allow them conveniently to act longer as joint-editors of the Journal, Mr. Thompson, their remaining colleague, has undertaken the sole editorship, on the condition that the sum of 300*l.* be placed annually at his disposal, for the purpose of procuring such subsidiary aid connected with the details of the work as he may find desirable. The Council have expressed unanimously to Mr. Acland and Mr. Hoskyns their sense of the high value they have attached to the services rendered by them in their co-operation with Mr. Thompson, during the period of their voluntary engagement; and they have gratefully accepted the offer of Mr. Thompson to continue his valuable services as the sole editor of the Journal.

The Council have adopted the following schedule of Prizes for Essays and Reports to be sent to the Secretary by the 1st of March next, namely:—

Results of Microscopic observation applied to the Vegetable Physiology of Agriculture	£50
Agriculture of the Islands of Jersey, Guernsey, Alderney, and Sark	25
Steam Cultivation	25
Extent to which Tillage operations act as a Substitute for Manure	20
Modification of Four-course Rotation consequent upon modern improvements	20
Varieties of Wheat, Barley, and Oats best adapted for high farming	20
Causes of the increasing difficulties of Turnip Cultivation, and the Remedies	20
Comparative Cost of high condition of land produced by purchased Cattle Food, or by purchased Manure	20
Any other Agricultural subject	10

Lectures have been delivered before the members by Professor Henfrey on Vegetable Physiology, and by Professor Simonds on the Composition of the Blood, and the Diseases with which that fluid is connected in the animal economy.

Professor Voelcker, the Consulting Chemist of the Society, has made to the members, at the weekly councils, various communications on points of practical interest connected with the adulteration of guano, and the feeding properties of cotton-seed cake. He has also recently presented to the Council, through the Chemical Committee, a detailed statement of the works carried on by him as the Chemist of the Society, in his Laboratory at Cirencester; and also a plan of the various arrangements he has in contemplation, in order that he may be enabled to increase the practical usefulness of his scientific labours. The Council have made additions to the schedule of privileges enjoyed by members of the Society who wish to avail themselves of Professor Voelcker's professional aid.

The Chester Meeting proved in every respect the most important one hitherto held by the Society; the number of visitors exceeded by many thousands the average amount of former years, and the liveliest interest was exhibited throughout the district in all the proceedings. The Mayor and Corporation, and the Local Committee acting under their authority, spared no efforts to render the meeting successful; while their hospitality and the cordial reception given by them to the members of the Society, were on all sides gratefully acknowledged. The show of Cheshire

cheese, and of the animals competing for the local prizes, added greatly to the interest which must under any circumstances have been excited by the excellent stock competing for the prizes of the Society, and by the trials and public working of the magnificent array of steam-engines and other agricultural implements and machinery sent to the meeting.

The Council have decided that the Warwick meeting shall be held in the week commencing Monday the 11th of July next. Already the requisite portions of land in that neighbourhood have been placed under suitable management for the purposes of the trials of implements; and the site of the show-yard has been surveyed by the Society's contractor of works, with a view to its being duly prepared, under the instructions of the Warwick Committee, for the exhibition of the stock and implements. The Council have adopted a series of local prizes, placed at their disposal by the Local Committee, to be competed for under the general regulations of the Society, and to be open to general competition, with the exception of the prizes for cheese, which will, at the request of the Local Committee, be restricted to cheese made within the county of Warwick. The Society's prizes for live stock will exceed by 58*l.* the total amount of prizes offered last year in this department; and third prizes have been added to the great majority of the classes for cattle, sheep, and pigs. The Council have decided to adopt several arrangements connected with the mode of distinguishing the prize animals, the restriction of local prizes to animals competing in these classes alone, and the management of refreshments for the public, which they hope will in each case be found to be improvements. The Council have also decided on the following prizes, to be offered in the department of implements at the Warwick meeting, namely:—

Class of Ploughs	£40
Class of Harrows	20
Class of Cultivators	20
Class of Clod-crushers	10
Class of Rollers	10
Class of Tile and Brick Machines	20
Class of Draining-machines and Implements	20
Special Prize for the best application of Steam-power to the Cultivation of the Soil	50
Miscellaneous Awards	Silver Medals.

The triennial system for the trial of implements, which commenced in 1855, at the Carlisle meeting, has terminated this year at Chester; and it has, therefore, been necessary for the Implement Committee, at the request of the Council, to take into their deliberate consideration the question of the renewal, discontinuance, or modification of that system. The Council have adopted the recommendation of the Committee, that, instead of three years, the trials should in future be distributed over a period of four years, the trials in the field and in the yard occurring every alternate year, such special prizes and medals for miscellaneous improvements being also offered each year as the Council may determine. The following is the schedule of this arrangement:—

I.—1859.—Ploughs, Harrows, Cultivators, Clod-crushers, Rollers, Tile and Brick Machines.

II.—1860.—Thrashing Machines, Chaff-cutters, Mills, Oil-cake Breakers.

III.—1861.—Drills, Manure-distributors, Horse-hoes, Hay Machines, Mowing Machines, Reaping Machines, Horse-rakes, Carts and Waggons.

IV.—1862.—Fixed and Portable Steam Engines, Fixed and Portable Finishing Machines, Hand Dressing Machines, Barley Hummellers.

They have also decided that, in future specifications of entry, "the prices stated shall be the prices of the respective articles of machinery, entered for competition and trial at the country meetings of the Society, *complete and in good working order*."

The Council have the satisfaction of recording the rapid advance of the Society in carrying out successfully the several objects for which it was established.

By order of the Council,

James Hudson, Secretary.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

Half-Yearly Account from the 1st of January to the 30th of June, 1858.

Receipts.

	£.	s.	d.
Balance in the hands of the Bankers, Jan. 1, 1858	331	15	11
Petty Cash Balance in the hands of the Secretary, Jan. 1, 1858	14	7	6
Dividends on Stock	134	18	4
Governor's Life-Composition	40	0	0
Governors' Annual Subscriptions	620	5	0
Members' Life-Compositions	251	0	0
Members' Annual Subscriptions	3529	10	0
Journal Receipts	236	17	1
Sale of Horse-shoeing Tracts	23	0	0
Country Meeting Receipts:—			
Salisbury	300	0	0
Chester	1831	6	3
Contribution from the Highland and Agricultural Society of Scotland towards the expenses of Professor Simonds's mission abroad in reference to the Cattle Plague	89	0	0
Ditto Royal Agricultural Improvement Society of Ireland	89	0	0
	£7491	0	1

Payments.

	£.	s.	d.
Permanent Charges	170	12	6
Taxes and Rates	10	10	6
Establishment Charges	619	14	6
Postage and Carriage	28	13	1
Advertisements	6	12	6
Journal Payments	1199	13	2
Essay Prize	20	0	0
Veterinary Grant	100	0	0
Balance to Professor Simonds on account of mission abroad in reference to the Cattle Plague	150	0	0
Chemical Grant	150	0	0
Country Meeting Payments:—			
Salisbury	948	0	7
Chester	1803	17	0
Subscriptions (overpaid by Bankers) returned	8	0	0
Horse-shoeing Tracts	40	8	6
Sundry items of Petty Cash	5	7	8
Balance in the hands of the Bankers, June 30, 1858	2225	15	9
Balance in the hands of the Secretary, June 30, 1858	3	14	4
	£7491	0	1

(Signed) THOMAS RAYMOND BARKER, *Chairman*, C. B. CHALLONER, } *Finance Committee.*

Examined, audited, and found correct, this 3rd day of Dec., 1858.

(Signed) WILLIAM ASTBURY, JOSEPH DRUCE, } *Auditors on the part of the Society.*

SHOW AT CHESTER: JULY, 1858.

STEWARDS OF THE YARD.

Stewards of Cattle.
ROBERT SMITH.
RICHARD MILWARD.
THOMAS PAIN.

Stewards of Implements.
SIR ARCHIBALD K. MACDONALD, BT.
CHARLES BARNETT.
COLONEL TOWNELEY.

Steward of Farm-Poultry.
THOMAS HARCOURT POWELL.

Steward of Cheese.
HENRY WHITE.

Honorary Director of the Show.
B. T. BRANDRETH GIBBS.

JUDGES.

Short-horns.
WILLIAM LADDS,
ANTHONY LAX MAYNARD,
THOMAS PARKINSON.

Herefords and Devons.
SAMUEL ANSTEY,
SAMUEL BLOXSIDGE,
EDWARD LANE FRANKLIN.

Other Breeds and Local Cattle.
WILLIAM TINDALL,
JAMES SINGER TURNER,
JOSEPH WOOLF.

Horses.
RICHARD BREWSTER,
WILLIAM CHARLES SPOONER.

CAPT. FREDERICK BARLOW,
C. M. NAINBY.

Leicester Sheep.
JOHN BODLEY,
CHARLES STOKES,
JOHN B. THOMPSON (of Anleby).

Southdown Sheep.
PETER PURVES,
EDWARD TRUMPER,
JOHN WATERS.

Long-woolled Sheep (not Leicesters).
HENRY BATEMAN,
CHARLES CLARKE,
ROBERT FISHER.

Short-woolled Sheep (not Southdowns).
JOSEPH BLUNDELL,
GEORGE BROWN,
HENRY THURNALL.

Pigs.
ARNOLD DENMAN,
CHARLES RANDELL,
THOMAS TROTTER.

Farm-Poultry.
JOHN BAILEY,
EDWARD HEWITT.

Implements—Steam-Engines.
BENJAMIN FOTHERGILL, C.E.,
WILLIAM OWEN, C.E.,
EDWARD WOODS, C.E.

Implements.
THOMAS H. BARKER,
JOHN CLARKE,
JOSEPH DRUCE,
JOHN HICKEN,
FIELDER KING,
GEORGE SHACKEL,
CHARLES W. WILLSHER,
JOHN WILSON.

Cheese and Butter.
CHARLES BATE,
EDWARD CORDEROY,
EDWARD HEWITT,
JOHN MOSS,
WILLIAM TILSTON,
JAMES WATSON.

Veterinary-Inspector.
PROFESSOR SIMONDS,
Royal Veterinary College.

Consulting-Engineer.
CHARLES EDWARDS AMOS,
(Firm of EASTON and AMOS).

AWARD OF PRIZES.

CATTLE: *Short-horns.*

LORD FEVERSHAM, of Duncombe Park, Helmsley, Yorkshire: the Prize of THIRTY SOVEREIGNS, for his 5 years 3 months 3 weeks and 3 days-old red and white Short-horned Bull "5th Duke of Oxford;" bred by the late Earl of Ducie, of Tortworth Court, Wootton-under-Edge, Gloucestershire.

MARK BARROBY, of Dishforth, Thirsk, Yorkshire: the Prize of FIFTEEN SOVEREIGNS, for his 3 years 10 months and 2 weeks-old white Short-horned Bull "Marc Antony;" bred by himself.

VISCOUNT HILL, of Hawkstone, Shrewsbury, Salop: the Prize of TWENTY-FIVE SOVEREIGNS, for his 1 year 10 months 3 weeks and 4 days-old roan Short-horned Bull "Hetman;" bred by himself.

STEWART MARJORIBANKS, of Bushey Grove, Watford, Herts: the Prize of FIFTEEN SOVEREIGNS, for his 1 year 8 months and 5 days-old roan Short-horned Bull "Great Mogul;" bred by himself.

FRANCIS HAWKSWORTH FAWKES, of Farnley Hall, Otley, Yorkshire: the Prize of TEN SOVEREIGNS, for his 11 months 2 weeks and 1 day-old white Short-horned Bull-calf "Bon Garçon;" bred by himself.

THOMAS FORREST, of Spurstow Hall, Tarporley, Cheshire: the Prize of FIVE SOVEREIGNS, for his 7 months-old roan Short-horned Bull-calf "Comet;" bred by himself.

RICHARD BOOTH, of Warlaby, Northallerton, Yorkshire: the Prize of TWENTY SOVEREIGNS, for his 4 years 2 months 3 weeks and 5 days-old roan Short-horned Cow, In-milk and In-calf, "Nectarine Blossom;" bred by himself.

RICHARD STRATTON, of Broad Hinton, Swindon, Wilts: the Prize of TEN SOVEREIGNS, for his 3 years and 3 months-old roan Short-horned Cow, In-milk and In-calf, "Matchless the 4th;" bred by himself.

JAMES DOUGLAS, of Athelstaneford Farm, Drem, East Lothian: the Prize of FIFTEEN SOVEREIGNS, for his 2 years 2 months and 4 days-old roan Short-horned In-calf Heifer "3rd Queen of Trumps;" bred by himself.

HON. REV. THOMAS HENRY NOEL HILL, of Berrington, Shrewsbury, Salop: the Prize of TEN SOVEREIGNS, for his 2 years 8 months 1 week and 2 days-old roan Short-horned Heifer "Lady Rockingham;" bred by himself.

RICHARD BOOTH, of Warlaby, Northallerton: the Prize of TEN SOVEREIGNS, for his 1 year 6 months 2 weeks and 2 days-old roan Short-horned Heifer "Queen of the Isles;" bred by himself.

LIEUTENANT-COLONEL CHARLES TOWNELEY, of Towneley Park, Burnley, Lancashire: the Prize of FIVE SOVEREIGNS, for his 1 year 1 month 1 week and 6 days-old roan Short-horned Heifer "Diadem;" bred by himself.

CATTLE: *Herefords.*

EDWARD PRICE, of Court House, Pembridge, Leominster, Hereford; the Prize of THIRTY SOVEREIGNS, for his 5 years and 11 months-old red-and-white Hereford Bull "Goldfinder the 2nd;" bred by John Perry, Cowarne, Hereford, Herefordshire.

THOMAS REA, of Westonbury, Pembridge, Herefordshire: the Prize of FIFTEEN SOVEREIGNS, for his 2 years 4 months 3 weeks and 4 days-old Hereford Bull "Sir Benjamin," red with white face and mane; bred by Benjamin Rogers, of the Grove, Pembridge, Herefordshire.

Richard Hill, of Golding Hall, Shrewsbury, Salop: the Prize of Twenty-five Sovereigns, for his 1 year 10 months and 1 week-old Hereford Bull "Claret," dark-red and white face; bred by himself.

John Naylor, of Leighton Hall, Welshpool, Montgomery: the Prize of Fifteen Sovereigns, for his 1 year 10 months 2 weeks and 5 days-old Hereford Bull "Lucknow," red with white face; bred by himself.

Thomas Edwards, of Wintercott, Leominster, Herefordshire: the Prize of Ten Sovereigns, for his 9 months 2 weeks and 2 days-old Hereford Bull-Calf "Leominster," red with white face and white mane; bred by himself.

Lord Bateman, of Shobdon Court, Leominster, Herefordshire: the Prize of Five Sovereigns, for his 11 months 3 weeks and 6 days-old Hereford Bull-Calf "Chester," red with white face; bred by himself.

Edward Williams, of Llowess Court, Hay, Breconshire: the Prize of Twenty Sovereigns, for his 5 years 7 months and 3 weeks-old Hereford Cow, In-calf, "Young Brawdy," red with white face and mane; bred by himself.

Philip Turner, of The Leen, Pembridge, Leominster, Herefordshire: the Prize of Ten Sovereigns, for his 9 years 8 months 1 week and 2 days-old Hereford Cow, In-milk, "Primrose," red body and white face; bred by himself.

Thomas Rea, of Westonbury, Pembridge: the Prize of Fifteen Sovereigns, for his 2 years and 7 months-old Hereford Heifer, In-calf, "Bella," red with white face and mane; bred by James Rea, Monaughty, Knighton, Radnorshire.

James Rea, of Monaughty, Knighton, Radnorshire: the Prize of Ten Sovereigns for his 2 years 7 months and 3 weeks-old Hereford Heifer, In-calf, "Heiress," dark-red with white face and white on top of shoulder; bred by himself.

James Rea, of Monaughty, Knighton: the Prize of Ten Sovereigns, for his 1 year 8 months and 5 days-old Hereford Heifer "Czarina," red with white face and white on top of shoulder; bred by himself.

William Child, of Wigmore Grange, Leintwardine, Ludlow: the Prize of Five Sovereigns, for his 1 year 9 months 3 weeks and 2 days-old Hereford Heifer "Peggy," brown with white; bred by himself.

Cattle: *Devons.*

Samuel Umbers, of Wappenbury, Leamington: the Prize of Thirty Sovereigns, for his 5 years 5 months 1 week and 2 days-old red Devon Bull "Birmingham 147;" bred by himself.

His Royal Highness the Prince Consort: the Prize of Fifteen Sovereigns, for his 3 years 8 months and 2 weeks-old red Devon Bull "The Zouave;" bred by George Turner, Barton, Exeter.

John Quartly, of Molland, Southmolton: the Prize of Twenty-five Sovereigns, for his 1 year 3 months and 1 week-old red Devon Bull; bred by himself.

George Turner, of Barton, Exeter: the Prize of Fifteen Sovereigns, for his 1 year 7 months and 2 weeks-old red Devon Bull "Clarendon;" bred by himself.

George Turner, of Barton, Exeter: the Prize of Ten Sovereigns, for his 8 months and 3 weeks-old red Devon Bull-Calf "Prince Leopold;" bred by himself.

His Royal Highness the Prince Consort: the Prize of Five Sovereigns, for his 9 months 1 week and 4 days-old red Devon Bull "The Colonel;" bred by himself.

John Quartly, of Molland: the Prize of Twenty Sovereigns, for his 5 years and 4 months-old red Devon Cow, In-milk and In-calf, "Picture;" bred by himself.

John Quartly, of Molland: the Prize of Ten Sovereigns, for his 5 years and 4 months-old red Devon Cow, In-milk and In-calf, "Milkmaid;" bred by himself.

Edward Pope, of Great Toller, Maiden Newton, Dorset: the Prize of Fifteen Sovereigns, for his 2 years 4 months and 1 week-old red Devon Heifer, In-calf, "Lovely;" bred by himself.

Edward Pope, of Great Toller, Maiden Newton: the Prize of Ten Sovereigns, for his 2 years 4 months and 2 weeks-old red Devon Heifer, In-calf, "Dove;" bred by himself.

James Quartly, of Molland House: the Prize of Ten Sovereigns, for his 1 year and 7 months-old red Devon Heifer; bred by himself.

George Turner, of Barton: the Prize of Five Sovereigns, for his 1 year 7 months and 2 weeks-old red Devon Heifer, In-calf, "Vaudine;" bred by himself.

Cattle: *Other established Breeds.*

Earl of Southesk, of Kinnaird Castle, Brechin, Forfar, N.B.: the Prize of Ten Sovereigns, for his 4 years 1 month and 1 week-old black polled Angus Bull "Druid;" bred by himself.

Lady Pigot, of Chippenham Park, Soham, Cambridgeshire: the Prize of Ten Sovereigns, for her 1 year 11 months 3 weeks and 4 days-old dun West Highland Bull "Glen Louan's Chief;" bred by Mr. MacTaydzeu, Glenamachree, Oban, Argyleshire.

Earl of Southesk, of Kinnaird Castle: the Prize of Ten Sovereigns, for his 4 years 11 months 2 weeks and 2 days-old black polled Angus Cow, In-milk and In-calf, "Dulcinea;" bred by himself.

Earl of Southesk, of Kinnaird Castle: the Prize of Ten Sovereigns, for his 2 years 10 months and 6 days-old black polled Angus Heifer, In-milk and supposed In-calf, "Oriana;" bred by himself.

Lord Sondes, of Elmham Hall, Thetford, Norfolk: the Prize of Five Sovereigns, for his 1 year 1 month and 2 weeks-old red Norfolk (polled) Heifer "Brenda;" bred by himself.

Horses.

George David Badham, of the Sparrow's Nest, Ipswich: the Prize of Thirty Sovereigns, for his 4 years-old chesnut Suffolk Agricultural Stallion "Emperor;" bred by himself; sire, "Newcastle Captain;" dam, "Maggy;" sire of dam, "Catlin's Old Boxer."

Matthew Berridge, of Ingarsby, Leicester: the Prize of Fifteen Sovereigns, for his 3 years and 2 months-old black Dishley Agricultural Stallion "Victor;" bred by Thomas Willey, Houghton-on-the-Hill, Leicester; sire, "Wallace;" sire of dam, "Merriman."

Thomas Crisp, of Butley Abbey, Woodbridge, Suffolk: the Prize of Twenty Sovereigns, for his 2 years-old chesnut Suffolk Agricultural Stallion "Plough-Boy;" bred by himself; sire, "Briton;" dam, "Darby;" sire of dam, Mr. Thomas Crisp's "Captain."

Benjamin Taylor, of Peterborough, Northampton: the Prize of Ten Sovereigns, for his 2 years-old Agricultural Stallion, "Young England's Glory;" bred by William Pauk, Boroughfen, Crowland, Northamptonshire; sire, "England's Glory; dam, "Sweep."

Isaac Fawkes, Outertown, Annan, Dumfries: the Prize of Twenty Sovereigns, for his 6 years and 2 months-old dark-brown Agricultural Mare, "Jessie," with her foal; bred by Mr. Weathershoons, Broom Houses, Lockerbie, Dumfries; sire, "Byron.

John Higson Hayes, of Frodsham, Chester: the Prize of Ten Sovereigns, for his 12 years-old black Agricultural Mare "Gipsy," with her foal; bred by Ann Leach, Alvanley, Frodsham, Chester; sire, "Grey Blaze."

Samuel Fisher, of Whatton, Nottingham: the Prize of Fifteen Sovereigns, for his 2 years 1 month 1 week and 2 days-old grey Agricultural Filly bred by himself; sire, "Young Champion;" dam, "Diamond."

Hon. Colonel Pennant, of Penrhyn Castle, Bangor: the Prize of Ten Sovereigns, for his 2 years 2 weeks and 6 days-old dark-bay Agricultural Cart Filly "Flower;" bred by Richard Williams, Bodafon, Llanenhynredd, Anglesey.

Duke of Marlborough, of Blenheim, Woodstock, Oxon: the Prize of Thirty Sovereigns, for his 9 years and 1 month-old grey Clydesdale Dray Stallion "Glengarry;" bred by Charles Philips Cracross, Brampton, Cumberland; sire, "Blythe;" dam, "Jean;" sire of dam, "Batchelor."

James Rawlence, of Bullbridge, Wilton, Wilts: the Prize of Fifteen Sovereigns, for his 2 years 3 months and 5 days-old brown Buckinghamshire Dray Stallion "Hillesden;" bred by Frederick Judge, Hillesden, Buckingham; sire, "Young Champion;" dam, "Bay Violet;" sire of dam, "Old Champion."

[No entry for the Prize of Ten Sovereigns offered for the best Dray Filly foaled in the year 1856.]

Thomas Manfield, of Thirkleby Bridge, Thirsk: the Prize of Thirty Sovereigns, for his 6 years-old bay Thorough-bred Stallion "Spencer," for getting hunters; bred by Captain Archdale, Archdale, Ireland; sire, "Cotherstone;" dam, "Polka;" sire of dam, "Emilius."

Christopher Spence, of Huntingdon Hall, York: the Prize of Twenty Sovereigns, for his 7 years-old chesnut Thorough-bred Stallion "Canute," for getting hunters; bred by William Stebbings, of Hambleton, Thirsk; sire, "Emper;" sire of dam, "Economist."

Richard Burton Ridsdale, of Watergate, Bishop Thornton, Ripley: the Prize of Twenty Sovereigns, for his 11 years-old chesnut roan Stallion "Troubadour," for getting hackneys; bred by himself; sire, "Sorcerer;" dam, "Polly Renton;" sire of dam, "Sir Tatton Sykes' Old President."

John Bayntun Starky, of Spye Park, Chippenham, Wilts: the Prize of Twenty Sovereigns, for his (about) 10 years-old chesnut Hunter Mare "Goldenlocks," for breeding hunters; sire, "Jack Tar."

John Lawdon Harland, of Bradley Green, Whitchurch, Chester: the Prize of Fifteen Sovereigns, for his 12 years-old grey Mare for breeding hackneys.

Sheep: *Leicesters.*

Thomas Edward Pawlett, of Beeston, Sandy, Beds: the Prize of Twenty Sovereigns, for his 1 year and 4 months-old Shearling Leicester Ram, bred by himself; sire, "G. E."

Robert Ward Creswell, of Ravenstone, Ashby-de-la-Zouch: the Prize of Ten Sovereigns, for his 1 year and 4 months-old Shearling Leicester Ram; bred by himself.

Thomas Edward Pawlett, of Beeston: the Prize of Twenty Sovereigns, for his 3 years and 4 months-old Leicester Ram; bred by himself.

Francis Spencer, of Claybrook Magna, Lutterworth: the Prize of Ten Sovereigns, for his 2 years 3 months and 6 days-old New Leicester Ram; bred by himself.

Lieutenant-Colonel William Inge, of Thorpe Constantine, Tamworth, Staffordshire: the Prize of Twenty Sovereigns, for his 1 year and 4 months-old Pen of five Shearling Leicester Ewes; bred by himself; sire, "Son of L. S."

Samuel Wiley, of Brandsby, York: the Prize of Ten Sovereigns, for his 1 year 3 months and 1 week-old Pen of five Shearling Leicester Ewes; bred by himself.

Sheep: *Southdowns.*

William Rigden, of Hove, Brighton: the Prize of Twenty Sovereigns, for his 1 year and 4 months-old Shearling Southdown Ram; bred by himself.

Duke of Richmond, of Goodwood, Chichester: the Prize of Ten Sovereigns, for his 1 year and 4 months-old Shearling Southdown Ram; bred by himself.

William Rigden, of Hove: the Prize of Twenty Sovereigns, for his 3 years and 4 months-old Southdown Ram; bred by himself.

Duke of Richmond, of Goodwood: the Prize of Ten Sovereigns, for his 2 years and 4 months-old Southdown Ram; bred by himself.

William Rigden, of Hove: the Prize of Twenty Sovereigns, for his 1 year and 4 months-old Pen of five Shearling Southdown Ewes; bred by himself.

Duke of Richmond, of Goodwood: the Prize of Ten Sovereigns, for his 1 year and 4 months-old Pen of five Shearling Southdown Ewes; bred by himself.

Sheep: *Long-wools (not Leicesters).*

William Lane, of Broadfield Farm, Northleach, Gloucestershire: the Prize of Twenty Sovereigns, for his 1 year 3 months and 1 week-old Shearling Cotswold Ram; bred by himself.

William Lane, of Broadfield Farm: the Prize of Ten Sovereigns, for his 1 year 3 months and 2 weeks-old Shearling Cotswold Ram; bred by himself.

William Hewer, of Hill House, Northleach, Gloucestershire: the Prize of Twenty Sovereigns, for his 2 years and 4 months-old Cotswold Ram; bred by himself.

Robert Garne, of Aldsworth, Northleach, Gloucestershire: the Prize of Ten Sovereigns, for his 3 years and 4 months-old Cotswold Ram; bred by the late William Garne, of Aldsworth, Northleach.

William Hewer, of Hill House: the Prize of Twenty Sovereigns, for his 1 year and 4 months-old Pen of five Shearling Cotswold Ewes; bred by himself.

William Lane, of Broadfield Farm: the Prize of Ten Sovereigns, for his 1 year 3 months and 3 weeks-old Pen of five Shearling Cotswold Ewes; bred by himself.

Sheep: *Short-woolled (not Southdowns).*

William Humfrey, of Oak Ash, Chaddleworth, Wantage, Berks: the Prize of Twenty Sovereigns, for his 1 year 4 months and 3 weeks-old dark-brown West Country Down Ram.

William Humfrey, of Oak Ash: the Prize of Ten Sovereigns, for his 1 year 5 months and 2 weeks-old light-brown West Country Down Ram; bred by himself.

Anne Baker, of Grendon, Atherstone, Warwick: the Prize of Twenty Sovereigns, for her 2 years 3 months and 2 weeks-old Shropshire Ram; bred by herself.

George Adney, of Harley, Much-Wenlock, Salop: the Prize of Ten Sovereigns, for his 4 years 3 months and 2 weeks-old Shropshire Down Ram "Patentee;" bred by himself: sire, "Buckskin."

William Humfrey, of Oak Ash: the Prize of Twenty Sovereigns, for his 1 year 4 months and 2 weeks-old dark-brown Pen of West Country Down Ewes; bred by himself.

Robert Coles, of Middleton Farm, Norton Bavant, Warminster, Wilts: the Prize of Ten Sovereigns, for his 1 year 4 months and 2 weeks-old five Shearling Improved Hampshire Down Ewes; bred by himself.

Pigs.

John Harrison, jun., of Heaton-Norris, Stockport, Lancashire: the Prize of Ten Sovereigns, for his 1 year 10 months and 1 week-old large white-and-spotted Boar "Young Wellington;" bred by Mr. Carswell, Park House, Butley, Macclesfield: sire, "Young Albert;" dam, "Miss Carswell;" sire of dam, J. Harrison's, jun., "Young Duke."

Joseph Gill, of Seisden, Silsden, York: the Prize of Five Sovereigns, for his 2 years 11 months and 4 days-old large white Boar "Lord Raglan;" bred by John Bullock and Co., Bradford, Yorkshire.

Samuel Brodhurst Hill, of Bach Hall, Chester: the Prize of Ten Sovereigns, for his 2 years and about 2 months-old small-breed Boar; bred by himself: sire of dam, "Young Thormanby."

Jonathan Brown, of Brewery House, Aspatria, Cumberland: the Prize of Five Sovereigns, for his 3 years-old small-breed Cumberland white Boar "Young Thormonby;" bred by himself; sire, "Thornby;" dam, "Miss Duce;" sire of dam, "Liberator."

Thomas Barker, of Brown's Yard, Great George-street, Woodhouse-lane, Leeds: the Prize of Ten Sovereigns, for his 2 years 1 month and 3 weeks-old large-breed white, with 1 blue-spot, Sow, "Lady Havelock;" bred by himself: sire, "Young Prince;" dam, "Yorkshire Pride;" sire of dam, "Hero."

Joseph Wilkinson, of Roundhay, near Leeds: the Prize of Five Sovereigns, for his 2 years and 5 days-old large white-and-spotted Sow "Queen Anne;" bred by William Bradshaw, Levenshulme, Manchester: sire, "Young Nelson;" dam, "Duchess;" sire of dam, "Milo."

Lieutenant-Colonel Charles Towneley, of Towneley Park: the Prize of Ten Sovereigns, for his 1 year 1 month 3 weeks and 2 days-old small-breed white Sow, "Matty;" bred by himself: sire, "Old Joe;" dam, "Broad Cheeks;" sire of dam, "Broad Back."

Joseph Hindson, of Barton House, Everton, Liverpool: the Prize of Five Sovereigns, for his 1 year 11 months and 2 weeks-old small-breed white Sow, "Perfection;" bred by himself: sire, "Surprise;" dam, "Beauty."

Edward Bowley, of Siddington House, Cirencester: the Prize of Ten Sovereigns, for his 7 months 3 weeks and 4 days-old Pen of three black (with a little white) Improved Berkshire Sow-Pigs, of large breed; bred by himself.

Samuel Wiley, of Brandsby, York: the Prize of Ten Sovereigns, for his 7 months 3 weeks and 1 day-old Pen of three small-breed Yorkshire Sow-Pigs; bred by himself.

Farm Poultry: *Dorkings.*

Captain William Windham Hornby, R.N., of Knowsley Cottage, Prescot, Lancashire: the Prize of Five Sovereigns, for his 5 months and 2 weeks-old grey Dorking Cock and two Pullets; bred by himself.

Captain William Windham Hornby, R.N., of Knowsley Cottage: the Prize of Three Sovereigns, for his 5 months and 3 weeks-old grey Dorking Cock and two Pullets; bred by himself.

Rev. Thomas Lyon Fellowes, of Beighton Rectory, Acle, Norfolk: the Prize of Two Sovereigns, for his 4 months and 2 weeks-old grey Dorking Cock and two Pullets; bred by himself.

John Robinson, of Vale House, Garstang, Lancaster: the Prize of One Sovereign, for his 4 months 1 week and 2 days-old white Dorking Cock and two Pullets; bred by himself.

Captain William Windham Hornby, R.N., of Knowsley Cottage: the Prize of Five Sovereigns, for his (above) 1 year-old grey Dorking Cock and two Hens; bred by himself.

Captain William Windham Hornby, R.N., of Knowsley Cottage: the Prize of Three Sovereigns, for his (above) 1 year-old grey Dorking Cock and two Hens; bred by himself.

Rev. John Hill, of The Citadel, Hawkstone, Shrewsbury: the Prize of Two Sovereigns, for his coloured Dorking Cock (above) 2 years-old and two Hens (above) 1 year-old; bred by himself.

John Dale Hewson, of Coton Hill, Stafford; the Prize of One Sovereign, for his 2 years-old coloured Dorking Cock and two Hens; bred by himself.

Farm Poultry: *Spanish.*

William Mence Lilly, of Monyhill Hall, Kingsnorton, Worcester: the Prize of Five Sovereigns, for his black Spanish Cock and two Hens.

Mrs. John Charles Hall, of Surrey House, Sheffield: the Prize of Three Sovereigns, for her 1 year and 2 months-old black Spanish Cock and two Hens; bred by herself.

William Wright Brundrit, of Churchfield House, Runcorn, Cheshire: the Prize of Two Sovereigns, for his black Spanish Cock (1 year 3 months and 6 days-old) and two Hens (1 year 2 months 2 weeks and 2 days-old); bred by himself.

James Dixon, of North Park, near Bradford, Yorkshire: the Prize of One Sovereign, for his 1 year 1 month and 3 weeks-old black Spanish Cock and two Hens; bred by himself.

Farm Poultry: *Game.*

Captain William Windham Hornby, R.N., of Knowsley Cottage: the Prize of Five Sovereigns, for his (above) 1 year-old red Game Cock and two Hens; bred by himself.

Joseph Hindson, of Barton House, Everton, Liverpool: the Prize of Three Sovereigns, for his 2 years-old light hackle, with black breast and tail, duck-wing Game Cock and two silver-grey Hens, 1 year and 1 month-old; bred by himself.

William Wright, of West Bank, Widnes, Warrington: the Prize of Two Sovereigns, for his 1 year and 3 months-old black-breasted red Game Cock and two Hens; bred by himself.

Henry Worrall, of Spring Grove, West Derby, Liverpool: the Prize of One Sovereign, for his 2 years and 3 months-old red Game Cock, and two Hens 1 year and 2 months-old; bred by himself.

Farm Poultry: *Cochin-China.*

Charles Punchard, of Blunts Hall, Haverhill, Suffolk: the Prize of Five Sovereigns, for his 2 years and 4 months-old buff Cochin-China Cock and two Hens; bred by himself.

Edgar Musgrove, of Aughton, near Ormskirk, Lancaster: the Prize of Three Sovereigns for his 2 years and 4 months-old buff Cochin-China Cock, and two Hens 2 years and 2 months-old; Cock bred by Thomas Stretch, of Marsh Lane, near Liverpool, the two Hens by Rev. — Gilbert, of Claxton, near Norwich.

William Mence Lilly, of Monyhill Hall: the Prize of One Sovereign, for his 2 years and 2 months-old white Cochin-China Cock and two Hens; bred by Robert Clease, Moseley-road, Birmingham.

Farm Poultry: *Brahma-Pootra.*

George Botham, Wexham Court, Slough, Bucks: the Prize of Three Sovereigns, for his 3 years 3 months and 2 weeks-old grey Brahma-Pootra Cock, and two Hens 2 years 4 months and 2 weeks-old; bred by himself.

Richard Teebay, of Fulwood, Preston, Lancashire: the Prize of Two Sovereigns, for his 1 year 2 weeks and 3 days-old black-and-white pea-combed dark Brahma-Pootra Cock, and two Hens 1 year 1 month 2 weeks and 2 days-old, light pencilled with dark; bred by himself.

John K. Fowler, of Prebendal Farm, Aylesbury: the Prize of One Sovereign, for his 5 months-old pencilled Brahma-Pootra Cock and two Hens; bred by himself.

Farm Poultry: *Hamburg.*

Edward Archer, of Malvern, Worcester: the Prize of Three Sovereigns, for his 1 year and 1 month-old silver-pencilled Hamburg Cock, and two Hens 1 year and 2 months-old; bred by himself.

Edward Archer, of Malvern: the Prize of Two Sovereigns, for his 1 year and 2 months-old silver-pencilled Hamburg Cock and two Hens; bred by himself.

Rev. Frederick Bell Pryor, of Bennington Rectory, Stevenage, Herts: the Prize of One Sovereign, for his 1 year 2 months and 2 weeks-old silver-pencilled Hamburg Cock and two Hens; bred by himself.

William Mence Lilly, of Monyhill Hall: the Prize of Three Sovereigns, for his 2 years and 1 month-old golden-pencilled Hamburg Cock, and two Hens 1 year and 1 month-old; bred by himself.

William Clare Worrall, of Rice House, Liverpool: the Prize of Two Sovereigns, for his 2 years-old golden-pencilled Hamburg Cock, and two Hens 1 year-old.

James Dixon, of North Park, near Bradford, Yorkshire: the Prize of One Sovereign, for his 1 year 1 month and 2 weeks-old golden-pencilled Hamburg Cock and two Hens; bred by himself.

Richard Teebay, of Fulwood: the Prize of Three Sovereigns, for his 2 years and 3 weeks-old white spangled with black silver-spangled silver mooney Hamburg Cock and two Hens; bred by himself.

William Mence Lilly, of Moneyhill Hall: the Prize of Two Sovereigns, for his 1 year and 1 month-old silver-spangled Hamburg Cock and two Hens.

George Botham, of Wexham Court, Slough: the Prize of One Sovereign, for his 1 year and 2 or 3 weeks-old silver-spangled Hamburg Cock and two Hens; bred by himself.

William Clare Worrall, of Rice House, Liverpool: the Prize of Three Sovereigns, for his 1 year-old golden-spangled Hamburg Cock, and two Hens 2 years-old.

William Robert Lane, of Bristol-road, Birmingham: the Prize of Two Sovereigns, for his golden-spangled Hamburg Cock and two Hens; Cock bred by Mrs. Bamfirth, of Holmfirth, Yorkshire.

James Dixon, of North Park: the Prize of One Sovereign, for his 1 year 1 month and 2 weeks-old golden-spangled Hamburg Cock and two Hens; bred by himself.

James Dixon, of North Park: the Prize of Four Sovereigns, for his 3 years-old golden Poland Cock, and two Hens 2 years 1 month and 1 week-old; Hens bred by himself.

James Dixon, of North Park: the Prize of Three Sovereigns, for his 2 years 1 month and 1 week-old black and white crested Poland Cock and two Hens.

James Dixon, of North Park: the Prize of Two Sovereigns, for his 2 years-old silver Poland Cock and two Hens; Hens bred by himself.

Henry Churchill, of Gloucester: the prize of One Sovereign, for his 2 years-old buff or chamois Poland Cock and two Hens; bred by himself.

Farm Poultry: *Geese.*

John Kersley Fowler, of Prebendal Farm: the Prize of Four Sovereigns, for his 3 years and 4 months-old grey cross-bred Gander and two Geese; bred by E. Terry, Aylesbury.

John Kersley Fowler, of Prebendal Farm: the Prize of Two Sovereigns, for his 2 years and 4 months-old grey Gander and two Geese; bred by himself.

Harriet Hill, of Stretton Grandison, Ledbury, Herefordshire: the Prize of One Sovereign, for her 1 year 1 month and 6 days-old mottled Embden and Toulouse Gander and two Geese; bred by herself.

Farm Poultry: *Ducks.*

John Kersley Fowler, of Prebendal Farm: the Prize of Three Sovereigns, for his 1 year and 4 months-old white Aylesbury Drake and two Ducks; bred by himself.

John Kersley Fowler, of Prebendal Farm: the Prize of Two Sovereigns, for his 12 weeks-old white Aylesbury Drake and two Ducks; bred by himself.

Henry Smith, of Sutton Maddock, Shiffnal, Shropshire: the Prize of One Sovereign, for his 14 weeks-old white Aylesbury Drake and two Ducks; bred by himself.

John Kersley Fowler, of Prebendal Farm: the Prize of Three Sovereigns, for his 12 weeks-old Rouen Drake and two Ducks; bred by himself.

Rev. Thomas Lyon Fellowes, of Beighton Rectory: the Prize of Two Sovereigns, for his 2 months 3 weeks and 4 days-old brown Rouen Drake and two Ducks; bred by himself.

John Kersley Fowler, of Prebendal Farm: the Prize of One Sovereign, for his 10 weeks-old Rouen Drake and two Ducks; bred by himself.

Elizabeth Steele Perkins, of The Cottage, Sutton Coldfield, Warwickshire: the Prize of Three Sovereigns, for her 8 weeks and 5 days-old black East Indian Drake and two Ducks; bred by herself.

James Dixon, of North Park: the Prize of Two Sovereigns, for his 1 year-old black East Indian Drake and two Ducks; bred by himself.

Henry Churchill, of Gloucester: the Prize of One Sovereign, for his 8 weeks-old black East Indian Drake and two Ducks; bred by himself.

Farm Poultry: *Turkeys.*

Thomas Lyon Fellowes, of Beighton Rectory: the Prize of Three Sovereigns, for his 2 years and 2 months-old grey Cambridge Turkey Cock and two Hens; bred by himself.

JOHN KERSLEY FOWLER, of Prebendal Farm: the Prize of TWO SOVEREIGNS, for his 1 year and 4 months-old black Norfolk Turkey Cock and two Hens; bred by A. Redrup, Longdown, Risborough, Bucks.

HARRIET HILL, of Stretton Grandison, Ledbury, Herefordshire: the Prize of ONE SOVEREIGN, for her 1 year and 1 month-old dark Norfolk American Wild Turkey Cock and two Hens; bred by herself.

Special Prizes,

FOR CATTLE BEST ADAPTED FOR DAIRY PURPOSES:

GIVEN BY THE CHESTER LOCAL COMMITTEE.

JOHN HANBURY BRADBURNE, of Pipe Place, Lichfield: the Prize of THIRTY SOVEREIGNS, for his 3 years 1 week and 5 days-old roan Short-horned Bull "Radford;" bred by Edmund Lythall, Radford Hall, Leamington: sire, "Saracen;" dam, "Ophelia;" sire of dam, "White Friar."

JOSHUA PRICE, of Featherstone, Wolverhampton: the Prize of FIFTEEN SOVEREIGNS, for his 3 years and 3 months-old roan Short-horned Bull "Sultan;" bred by Edmund Lythall, of Radford Hall, Leamington: sire, "Saracen;" dam, "Strawberry;" sire of dam, "Daylight."

HON. COLONEL PENNANT, of Penrhyn Castle: the Prize of FIFTEEN SOVEREIGNS, for his 1 year 4 months 2 weeks and 2 days-old roan Short-horned Bull "Sir Colin Campbell;" bred by himself: sire, "The Brown;" dam, "Nonpareil;" sire of dam, "Matadore."

HON. AND REV. THOMAS HENRY NOEL HILL, of Berrington, Shrewsbury: the Prize of TEN SOVEREIGNS, for his 1 year 8 months 1 week and 2 days-old roan Short-horned Bull "Attingham;" bred by himself: sire, "May Duke;" dam, "Lady Valentine 3rd;" sire of dam, "Monk."

HENRY AMBLER, of Watkinson Hall Farm, Halifax: the Prize of THIRTY SOVEREIGNS, for his 5 years and 1 month-old roan Short-horned In-milk and In-calf Cow "Foundling;" bred by John Land, York: sire, "Snowball;" dam, "Fanny;" sire of dam, "Benjamin:" and his 4 years and 2 months-old roan Short-horned Cow, In-milk, "Woodbine;" bred by Richard Dudding, of Panton, Wragby, Lincolnshire: sire, "Baron Warlaby;" dam, "Westeria;" sire of dam, "Duke of York."

RICHARD STRETTON, of Broad Hinton: the Prize of FIFTEEN SOVEREIGNS, for his 6 years 3 months 3 weeks and 5 days-old roan Short-horned Cow, In-milk and In-calf, "Clarissa;" bred by himself: sire, "Hero of the West;" dam, "Mace;" sire of dam, "Red Duke:" and 7 years 3 months and 2 weeks-old red roan Short-horned Cow, In-calf, "Blossom;" bred by himself: sire, "Red Duke;" dam, "Blossom;" sire of dam, "Son of Phœnix."

JOHN CHURTON, of Barrel Well House, Chester: the Prize of TEN SOVEREIGNS, for his 7 years-old roan cross-bred pair of Cows, In-milk.

JOSHUA PRICE, of Featherstone: the Prize of FIFTEEN SOVEREIGNS, for his 2 years 1 month and 3 weeks old red roan Short-horned Heifer, In-calf, "Vapour;" bred by W. F. Fryer, of Wolverhampton: sire, "Musician:" and his 2 years 1 month 3 weeks and 5 days-old red roan Short-horned Heifer, In-calf, "Queen Elizabeth;" bred by W. F. Fryer, of Wolverhampton: sire, "Musician;" dam, "Duchess of Wellington;" sire of dam, "Duke of Oxford."

HON. COLONEL PENNANT, of Penrhyn Castle: the Prize of TEN SOVEREIGNS, for his 1 year 11 months and 1 week-old dark roan Short-horned Heifer,

In-calf, "Lavinia:" sire, "Frogmore;" dam, "Trifle:" and his 1 year and 11 months-old light roan Short-horned Heifer, In-calf, "La Favorite:" sire, Prince Arthur;" dam, "La Juna;" both bred by himself.

John Dawson, of Gronant, Rhyl, Flint: the Prize of Five Sovereigns, for his 2 years 11 months 1 week and 4 days-old white "Improved Short-horned" Heifer, In-calf, "Lowry:" sire, "Irish Boy;" dam, "Lavender;" sire of dam, "Sir William Fairfax:" and his 2 years and 11 months-old red and white "Improved Short-horned" Heifer, In-calf, "Fancy;" sire, "Irish Boy;" dam, "Flora;" sire of dam, "Sir William Fairfax;" both bred by himself.

Joshua Price, of Featherstone: the Prize of Ten Sovereigns, for his 1 year 1 month and 5 days-old roan Short-horned Heifer: sire, "Musician;" dam, "Snowball:" and his 1 year 2 months and 2 days-old red roan Short-horned Heifer: sire, "Musician;" dam, "Strawberry;" both bred by himself.

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Five Sovereigns, for his 1 year 6 months and 27 days-old Short-horned Heifer "Phœbe:" sire, "Lovemore:" and his 1 year 5 months 3 weeks and 4 days-old Short-horned Heifer "Eglantine:" sire, "Prince Arthur;" both bred by himself.

Cattle: *Welsh Breeds.*

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Thirty Sovereigns, for his 2 years 1 month and 2 weeks-old black Welsh Bull "Llandaff;" bred by John Oliver, of Tanyfonwant, Llanestun, Beaumaris, Anglesey.

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Fifteen Sovereigns, for his 2 years 2 months and 2 weeks-old black Welsh Bull "Malmesbury;" bred by Mary Williams, Llanerchyrnede, Anglesey.

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Thirty Sovereigns, for his 3 years 2 months 3 weeks and 5 days-old black Welsh Bull "Llywelyn;" bred by William Owen, of Tai-Cochion, Carnarvon, Anglesey.

Sir Richard Bulkeley Williams Bulkeley, Bart., M.P., of Baron Hill, Beaumaris, Anglesey: the Prize of Fifteen Sovereigns, for his 5 years 2 months and 2 weeks-old black Welsh Bull "Triumph;" bred by Edward Jones, of Clovach-Fawr, near Llanerchymedd, Anglesey.

Sir Richard Bulkeley Williams Bulkeley, Bart., M.P., of Baron Hill: the Prize of Twenty Sovereigns, for his 8 years and 6 months-old black Welsh Cow, In-milk, "Flora;" bred by Richard Williams, Bodafon, Llanerchymedd, Anglesey.

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Fifteen Sovereigns, for his 6 years and (about) 3 months-old black Welsh Cow, In-calf, "Beauty;" bred by Hugh Roberts, of Nante, Beaumaris, Anglesey.

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Ten Sovereigns, for his 11 years 2 months and 3 weeks-old brindle Welsh Cow, In-calf, "Anglesey;" bred by Mr. Williams, Brynglass, Beaumaris, Anglesey.

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Fifteen Sovereigns, for his 1 year and 3 months-old black Welsh Heifer; bred by William Owen, Tai-Cochion, Carnarvon, Anglesey: sire, "Llywelyn."

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Ten Sovereigns, for his 1 year 3 months and 3 weeks-old black Welsh Heifer; bred by William Owen, Tai-Cochion, Carnarvon, Anglesey: sire, "Llywelyn."

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Five Sovereigns, for his 1 year 1 month and 2 weeks-old black Welsh Heifer; bred by himself: dam, "Beauty."

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Fifteen Sovereigns, for his 2 years and 3 months-old black Welsh Heifer, In-calf, "Queen Maude;" bred by Morris Jones, of Bryncyttyn, near Nevin, Carnarvon.

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Ten Sovereigns, for his 2 years 5 months 3 weeks and 3 days-old black Welsh Heifer, In-milk and In-calf, "Joan;" bred by Richard Williams, Bodafon, Llanerchymedd, Anglesey.

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Five Sovereigns, for his 2 years and 4 months-old black Welsh Heifer, In-calf, "Claudia;" bred by James Rowlands, of Cochsidea, Carnarvon.

Cattle: *Established Breeds other than Short-horn, Hereford, or Devon.*

To the Winner of the Society's Prizes for "Other Established Breeds."

Earl of Southesk, of Kinnaird Castle: the Prize of Fifteen Sovereigns, for his 4 years 1 month and 1 week-old black Polled Angus Bull "Druid;" bred by himself: sire, "Cupbearer;" dam, "Dora."

Lady Pigot, of Chippenham Park: the Prize of Fifteen Sovereigns, for her 1 year 11 months 3 weeks and 4 days-old dun West Highland Bull "Glen Lowan's Chief;" bred by Mr. M'Faydzen, of Glenamachree, near Oban, Argyleshire: sire, "Beoch Boich."

Horses.

E. and M. Reed, of Beamish Burn, Chester-le-Street, Durham: the Prize of Thirty Sovereigns, for their 9 years-old bay Agricultural Stallion "Nonpareil;" bred by William Wright, of Stonesby, Melton Mowbray: sire, "Samson;" sire of dam, "Plough Boy."

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Twenty Sovereigns, for his 7 years-old dapple-grey Agricultural Cart Stallion "Matchless;" bred by Thomas Hayto, of Sempringham Fen, Falkingham, Lincolnshire: sire, "King of the Country;" sire of dam, "Champion."

Thomas Crisp, of Butley Abbey, Woodbridge, Suffolk: the Prize of Twenty Sovereigns, for his 2 years-old chesnut Suffolk Agricultural Stallion "Plough Boy;" bred by himself: sire, "Briton;" dam, "Darby;" sire of dam, Thomas Crisp's "Captain."

Benjamin Taylor, of Peterborough: the Prize of Ten Sovereigns, for his 2 years-old bay Agricultural Stallion "Young England's Glory;" bred by William Pank, of Boroughfen, Crowland, Northamptonshire: sire, "England's Glory; dam, "Sweep."

William Palin, of Stapleford Hall, Tarvin Chester: the Prize of Ten Sovereigns, for his 4 years and 1 month-old grey Agricultural Mare "Flower," and his 4 years 1 month and 2 weeks-old grey Agricultural Mare "Jolly;" both bred by himself: sire, "King William."

Samuel Lees, of Newton Danes, Preston Brook, Cheshire: the Prize of Five Sovereigns, for his 4 years-old Agricultural Horse "Captain," and his 6 years-old Agricultural Mare "Madam."

Samuel Lees, of Newton Danes, Preston Brook: the Prize of Ten Sovereigns, for his 1 year-old brown Agricultural Filly; bred by himself.

Hugh Hughes, of Wood Farm, Shorley, Flints: the Prize of Fifteen Sovereigns, for his 8 years and 4 months-old bay Dray Stallion "Young Marquis;" bred by Hugh Hughes, of Oak Farm, Hawarden, Flints: sire, "The Marquis of Hope;" sire of dam, "Young Blaze."

Christopher Spence, of Huntington Hall, York: the Prize of Thirty Sovereigns, for his 7 years-old chesnut Thorough-bred Stallion "Canute," for getting hunters; bred by William Stebbings, of Hambleton, Thirsk; sire, "Emper;" sire of dam, "Economist."

James Baker, of Atherstone, Warwickshire: the Prize of Twenty Sovereigns, for his 10 years-old Thorough-bred Stallion "Comeaway," for getting hunters; bred by R. Thompson: sire, "Comrade;" dam, "Bushford Lass;" sire of dam, "Sancho," by "Don Quixote."

James Moffat, Crosby-on-Eden, Carlisle: the Prize of Ten Sovereigns, for his 6 years-old dark-bay and black-legged Mountain Pony Stallion "Highland Laddie," bred by Mr. Bell, Annan, Dumfriesshire; sire, "Mountain Ranger."

Sir Watkin Williams Wynn, of Wynnstay, Ruabon, Denbighshire: the Prize of Five Sovereigns, for his aged blue-roan Mountain Pony Stallion "Toby."

James Rea, of Monaughty, Knighton, Radnor: the Prize of Ten Sovereigns, for his (upwards of) 20 years old bay Mountain Pony Mare "Old Bessy," with her foal.

John Edmunds, of Ivy House, Chirk, Denbighshire: the Prize of Five Sovereigns, for his 8 years-old bay Mountain Pony Mare "Jenny," with her foal; bred by Mr. Peate, of Penterlawil, near Oswestry, Salop; sire of mare, "Billy;" sire of foal, "King Frederick."

Sir Pyers Mostyn, Bart., of Talacre, Rhyl, Flints: the Prize of Ten Sovereigns, for his 10 years-old bay Welsh Talacre Stallion Pony "Young Bantam;" bred by himself: sire, "Old Bantam."

Silvanus Edwards, of Orton, Wolverhampton: the Prize of Five Sovereigns, for his 7 years-old dark-brown Welsh Half-bred Stallion Pony "Dick;" bred by himself: sire, Matchless;" dam, "Jenny."

Sir Pyers Mostyn, Bart., of Talacre: the Prize of Ten Sovereigns, for his 5 years-old brown Talacre Pony Mare "Brunette," with her foal; bred by himself: sire, "Young Bantam;" dam, "Vestris:" sire of dam, "Old Bantam."

Thomas Wilcoxon, of Upton, Chester: the Prize of Five Sovereigns, for his 5 years-old bright-bay Half-bred Pony Mare, "Jesse," with her foal; bred by Samuel Cleveland, Northgate-street, Chester: sire, "Pyrland."

Robert Heath, of Hefferston Grange, Weaverham, Northwich, Cheshire: the Prize of Ten Sovereigns, for his 2 years-old dark-bay Half-bred Filly "Pretty Boy," for hunting purposes; bred by himself: sire, "His Grace;" dam, "Dolly."

Thomas Parker, of Aldford, Chester: the Prize of Ten Sovereigns, for his 1 year 3 months and 1 day-old bay Thorough-bred Colt; bred by himself: sire, "Grosvenor;" dam, "Common Sense;" sire of dam, "Melbourne."

Sheep.

Hon. Colonel Pennant, of Penrhyn Castle, Bangor: the Prize of Fifteen Sovereigns, for his 2 years and 2 months-old Welsh Mountain Ram; bred by himself.

David Roberts, of Plas yn y Cornel, Llansaman, Abergele, Denbigh: the Prize of Ten Sovereigns, for his 5 years-old White Welsh Mountain Ram; bred by himself.

Thomas Roberts, of Bodidris, Llandegla, Denbigh: the Prize of Fifteen Sovereigns, for his 3 and 4 years-old Pen of five Welsh Ewes; bred by himself.

Robert Basherville Mynors, of Evancoyd, Presteigne, Radnor: the Prize of Ten Sovereigns, for his 3 years and a few months-old Pen of five Welsh Ewes; bred by himself.

Robert Basherville Mynors, of Evancoyd: the Prize of Five Sovereigns, for his 1 year and (about) 3 months-old Pen of five Welsh Ewes; bred by himself.

William Orme Foster, of Kinver Hill Farm, Stourbridge, Worcestershire: the Prize of Twenty Sovereigns, for his 1 year 3 months and 2 weeks-old Shropshire Down Ram, brown face and legs; bred by himself: sire, "Perfection."

James and Edward Crane, of Shrawardine, Shrewsbury: the Prize of Ten Sovereigns, for their 1 year 3 months and 2 weeks-old Shropshire Ram; bred by themselves.

Anne Baker, Grendon, Atherstone, Warwick: the Prize of Twenty Sovereigns, for her 2 years 3 months and 2 weeks-old Shropshire Ram; bred by herself.

George Adney, of Harley, Much-Wenlock: the Prize of Ten Sovereigns, for his 2 years 3 months and 2 weeks-old Shropshire Down Ram "Earl of Salisbury;" bred by himself: sire "Buckshin."

James and Edward Crane, of Shrawardine, Shrewsbury: the Prize of Fifteen Sovereigns, for their 1 year 3 months and 2 weeks-old Pen of five Shearling, Shropshire Down Ewes; bred by themselves.

James and Edward Crane, of Shrawardine, Shrewsbury: the Prize of Ten Sovereigns, for their 1 year and 3 months-old Pen of five Shearling Shropshire Down Ewes; bred by themselves.

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Twenty Sovereigns, for his 1 year and 3 months-old Shearling Cheviot Ram; bred by Thomas Elliot, of Hindhope, Jedburgh, Roxburghshire.

Henry Robertson, Sandbach, of Hafodunos, Llanrwst, Denbigh: the Prize of Ten Sovereigns, for his 1 year 2 months and 2 weeks-old Shearling Cheviot Ram; bred by himself: sire, "Green Sykes."

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Twenty Sovereigns, for his 4 years and 3 months-old Cheviot Ram; bred by Thomas Elliot, of Hindhope, Jedburgh, Roxburghshire.

Henry Robertson Sandbach, of Hafodunos: the Prize of Ten Sovereigns, for his 4 years and 3 months-old Cheviot Ram "Green Sykes;" bred by Thomas C. Borthwich, of Hopsrig, Langham, Dumfriesshire: sire, "Albion."

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Twenty Sovereigns, for his 1 year 2 months and 2 weeks-old Pen of five Shearling Cheviot Ewes; bred by Thomas Elliot, of Hindhope, Jedburgh, Roxburghshire.

Henry Robertson Sandbach, of Hafodunos: the Prize of Ten Sovereigns, for his 1 year 2 months and 2 weeks-old Pen of five Shearling Cheviot Ewes; bred by himself.

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Ten Sovereigns, for his 4 and 5 years-old Pen of five Cheviot Ewes; bred by James Brydon, of Moodlan, Longholme, Dumfriesshire.

Hon. Colonel Pennant, of Penrhyn Castle: the Prize of Five Sovereigns, for his 3 years-old Pen of five Cheviot Ewes; bred by the late Nicholas Reid, Oldtown, Otterburn, Newcastle-on-Tyne.

William Orme Foster, of Kinver Hill Farm, Stourbridge, Worcestershire: the Prize of Ten Sovereigns, for his two 11 years 3 months and 2 weeks-

old, two 9 years 3 months and 2 weeks-old, and one 7 years 3 months and 2 weeks-old Pen of five Shropshire Down Ewes, dark-brown face and legs; bred by Samuel Meire, Castle Hill, Harley, Much-Wenlock.

WILLIAM ORME FOSTER, of Kinver Hill Farm, Stourbridge: the Prize of FIVE SOVEREIGNS, for his two 3 years 3 months and 2 weeks-old, and three 2 years 3 months and 2 weeks-old Pen of five Shropshire Down Ewes, dark-brown face and legs; bred by himself.

PIGS.

PETER WRIGHT, of Minshull, Church Minshull, Cheshire: the Prize of FIVE SOVEREIGNS, for his 2 years and 9 months-old blue-and-white large-breed Sow, with litter of Pigs; bred by himself; sire, "Champion."

LIEUTENANT-COLONEL CHARLES TOWNELEY, Towneley Park, Burnley: the Prize of FIVE SOVEREIGNS, for his 1 year 1 month 3 weeks and 2 days-old white Small-breed Sow "Matty;" bred by himself: sire, "Old Joe," dam, "Broad Cheeks;" sire of dam, "Broad Back."

Commendations.

The mark * signifies "SPECIALLY COMMENDED;" the mark † "HIGHLY COMMENDED;" the mark ‡ "COMMENDED" (distinctly and individually); and the omission of these marks, "GENERALLY COMMENDED" (as part of a whole class).

CATTLE.

†GEORGE BLAND, of Coleby Hall, Lincoln: for his 3 years 8 months 3 weeks and 4 days-old roan Short-horned Bull "Lord Raglan;" bred by William Smith, West Rasen, Market Rasen.

†WILLIAM WETHERELL, of Aldborough, Darlington: for his 2 years 7 months 1 week and 4 days-old white Short-horned Bull "Statesman;" bred by himself.

‡JOHN HANBURY BRADBURNE, of Pipe-place Lichfield: for his 3 years 1 week and 5 days-old roan Short-horned Bull "Radford;" bred by Edmund Lythall, of Radford Hall, Leamington.

‡HON. AND REV. THOMAS HENRY NOEL HILL, of Berrington, Shrewsbury: for his 5 years 1 month 2 weeks and 5 days-old red (with little white) Short-horned Bull "May Duke;" bred by Edward Bolden, Springfield House, Lancaster.

‡SIR CHARLES ROBERT TEMPEST, Bart., of Broughton Hall, Skipton: for his 2 years 3 months and 28 days-old roan Short-horned Bull "Emperor Napoleon;" bred by John Unthank, of Netherscales, Penrith.

‡RICHARD STRATTON, of Broad-Hinton: for his 2 years 4 months and 3 weeks-old roan Short-horned Bull "Victory;" bred by himself.

‡WILLIAM WETHERELL, of Aldborough: for his 3 years 8 months 2 weeks and 3 days-old roan Short-horned Bull "Lord Scarboro;" bred by himself.

†HON. COLONEL PENNANT, of Penrhyn Castle: for his 1 year 4 months 2 weeks and 2 days-old roan Short-horned Bull "Sir Colin Campbell;" bred by himself.

†FRANCIS HAWKSWORTH FAWKES, of Farnley Hall, Otley: for his 1 year 2 months 3 weeks and 5 days-old roan Short-horned Bull "Sultan;" bred by himself.

‡FRANCIS HAWKSWORTH FAWKES, of Farnley Hall: for his 1 year 3 months and 5 days-old red Short-horned Bull "Don Giovanni;" bred by himself.

‡HON. AND REV. THOMAS HENRY NOEL HILL, of Berrington: for his 1 year 8 months 1 week and 2 days-old roan Short-horned Bull "Attingham;" bred by himself.

‡HENRY EDWARD SURTEES, of Dane End, Ware: for his 1 year 5 months and 3 days-old roan Short-horned Bull "Marquis of Lorn;" bred by himself.

‡William Torr, of Aylesby Manor, Grimsby: for his 1 year 6 months 1 week and 6 days-old white Short-horned Yearling Bull "Silver Star;" bred by himself.

†Lieutenant-Colonel Charles Towneley, of Towneley Park: for his 10 months 2 weeks and 4 days-old roan Short-horned Bull Calf "The Royal Butterfly;" bred by himself.

‡John Grundy, The Dales, Stand, Manchester: for his 8 months and 2 days-old red-and-white Short-horned Bull Calf "Vandervelde;" bred by himself.

‡Mark Barroby, of Dishforth, Thirsk; for his 9 months 2 weeks and 2 days-old white Short-horned Bull Calf "Hallikeld;" bred by himself.

‡Sir William Lawson, Bart., of Brough Hall, Katterick, Yorkshire: for his 8 months and 5 days-old light roan Short-horned Bull Calf "Lord Stanley;" bred by himself.

‡John Armstrong, of Palterton, Chesterfield: for his 10 months-old white Short-horned Bull Calf "Vatican;" bred by himself.

‡Lieutenant-Colonel Charles Towneley, of Towneley Park: for his 11 months 3 weeks and 4 days-old red Short-horned Bull Calf "Frederick's Lad;" bred by himself.

†William Wetherell, of Aldborough: for his 5 years 2 months 1 week and 2 days-old roan Short-horned Cow, In-calf, "Moss Rose;" bred by William Harrison, Close House, Darlington.

Stewart Marjoribanks, of Bushey Grove, Watford: for his 3 years 7 months and 4 weeks-old red Short-horned Cow, In-milk and In-calf, "Ruby 4th;" bred by Lieutenant-Colonel Charles Towneley, of Towneley Park.

John Dawson, of Gronant, Rhyl: for his 5 years 11 months 1 week and 3 days-old roan Improved Short-horned Cow, In-milk, "Lassy;" bred by himself.

James Douglas, of Athelstaneford: for his 3 years 6 months and 1 week-old roan Short-horned Cow, In-milk and In-calf, "Rose of Athelstane;" bred by himself.

James Douglas, of Athelstaneford: for his 4 years 9 months and 3 weeks-old roan Short-horned Cow, In-milk and In-calf, "Ringlet;" bred by Lieutenant-Colonel Towneley, of Towneley Park.

Joshua Price, of Featherstone, Wolverhampton: for his 6 years 5 months and 4 days-old red roan Short-horned Cow "Princess;" bred by Captain Delks, Maxtoke Castle.

Richard Stratton, of Broad Hinton: for his 4 years 1 month and 3 weeks-old white Short-horned Cow, In-milk and In-calf, "Matchless the 3rd;" bred by himself.

Edward Bate, of Kelsterton, Flint: for his 5 years 3 months and 3 weeks-old white Short-horned Cow, In-calf, "Nerissa 6th;" bred by himself.

Edward Bowley, Siddington House, Cirencester: for his 7 years and 7 months-old roan pure Short-horned Cow, In-milk, "Melody;" bred by himself.

†James Douglas, of Athelstaneford Farm: for his 2 years 5 months and 6 days-old white Short-horned Heifer, In-calf, "Venus de Medicis;" bred by the late John Booth, of Killerby, Catterick.

†Lieutenant-Colonel Charles Towneley, of Towneley Park: for his 2 years 10 months and 2 days-old roan Short-horned Heifer, In-milk, "The Rose of Towneley;" bred by himself.

‡John Bayntun Starky, of Spye Park, Chippenham: for his 2 years and 2 months-old roan-and-white Short-horned Heifer, In-calf, "May Day;" bred by himself.

†John Grundy, of The Dales, Stand, Manchester: for his 1 year 6 months and 29 days-old roan Short-horned Yearling Heifer "Sweetheart;" bred by himself.

†Lord Feversham, of Duncombe Park: for his 1 year 9 months 1 week and 5 days-old red and white Short-horned Heifer "Symphony;" bred by Stewart Majoribanks, of Bushey Grove, Watford.

†Sir Charles Robert Tempest, Bart., of Broughton Hall: for his 1 year 10 months 2 weeks and 3 days-old white Short-horned Heifer, In-calf, "Crinoline;" bred by himself.

†Lieutenant-Colonel Charles Towneley, of Towneley Park: for his 1 year

11 months 3 weeks and 2 days-old red Short-horned Heifer "Emma;" bred by himself.

‡WILLIAM BARKER COX, of Pickering, Yorkshire: for his 1 year 3 months 3 weeks and 3 days-old roan Short-horned Heifer "Coquette;" bred by John Thomas Robinson, Leckby Palace, Thirsk.

‡WILLIAM FLETCHER, Radmanthwaite, Mansfield: for his 1 year 8 months and 6 days-old roan Short-horned Heifer "Eugenie;" bred by himself.

‡LIEUTENANT-COLONEL CHARLES TOWNELEY, of Towneley Park: for his 1 year 1 month and 5 days-old roan Short-horned Heifer "Evadne;" bred by himself.

‡LIEUTENANT-COLONEL CHARLES TOWNELEY, of Towneley Park: for his 1 year 1 month 2 weeks and 4 days-old white Short-horned Heifer "Fidelity;" bred by himself.

†LORD BATEMAN, Shobdon Court, Leominster: for his 5 years 9 months 2 weeks and 5 days-old red (white-faced) Hereford Bull "Carlisle;" bred by the Earl of Radnor, Coleshill, Highworth, Berks.

‡LORD BERWICK, of Cronkhill, Shrewsbury: for his 3 years 6 months and 1 day-old red (white-faced) Hereford Bull "Severn;" bred by himself.

†JOHN WILLIAMS, of Kingsland, Leominster: for his 1 year and 11 months-old red (white-faced) Hereford Bull "Sir Colin;" bred by himself.

‡EDMUND WRIGHT, of Halston, Oswestry: for his 1 year 6 months 3 weeks and 3 days-old dark red and white Hereford Bull "Charley;" bred by himself.

†WILLIAM PERRY, of Saint Oswald, Cholstrey, Leominster: for his 11 months and 5 days-old red (white-faced) Hereford Bull-Calf "Goldfinder;" bred by himself.

†WALTER GREENHOUSE, of Kingsland, Leominster: for his 10 months-old dark-red (white-faced) Hereford Bull; bred by himself.

‡EDMUND WRIGHT, of Halston: for his 11 months and 1 day-old red-and-white Hereford Bull "Halston;" bred by himself.

†GEORGE PITT, of Chadnor Court, Dilwyn, Leominster: for his 10 years 8 months 1 week and 6 days-old red (white-faced) Hereford Cow, In-milk, "Highlass;" bred by himself.

PHILIP TURNER, of The Leen, Pembridge, Leominster: for his 3 years 8 months 1 week and 6 days-old red (white-faced) Hereford Cow, In-milk and In-calf, "Graceful;" bred by himself.

JAMES ACKERS, of Prinknash Park, Painswick, Gloucestershire: for his 5 years 7 months and 2 weeks-old red (white-faced) Hereford Cow, In-calf, "Miss Tomkins the 3rd;" bred by himself.

WILLIAM STEDMAN, of Bedstone Hall, Aston, Shrewsbury: for his 6 years 1 month and 2 days-old blood-red (white-faced) Hereford Breeding Cow, In-milk and In-calf, "Perfection;" bred by himself.

WILLIAM STEDMAN, of Bedstone Hall: for his 5 years 5 months and 2 weeks-old blood-red (white mane and face) Hereford Breeding Cow, In-milk and In-calf, "The Countess of Shrewsbury;" bred by himself.

THOMAS BEALE BROWNE, of Hampen, Andoversford, Gloucester: for his 4 years 8 months 1 week and 4 days-old red-and-white Hereford Cow, In-milk and In-calf, "Prettyman:" bred by Philip Turner, of The Leen, Pembridge.

THOMAS TAYLOR, of Burleigh Villa, Wellington, Shropshire: for his 5 years and 8 months-old white Hereford Cow, In-milk and In-calf, "Lily White;" bred by himself.

†WILLIAM PERRY, of Saint Oswalds, Cholstrey, Leominster: for his 2 years 6 months 1 week and 3 days-old red (white face and dark spot) Hereford Heifer, In-calf, late "Young Prettymaid," now "Worcester Spot;" bred by himself.

‡WILLIAM PERRY, of Saint Oswalds: for his 2 years 7 months and 2 days-old red (white-faced) Hereford Heifer, In-calf, late "Young Duchess," now "Flower of Worcester;" bred by himself.

†RICHARD HILL, of Golding Hall, Shrewsbury: for his 1 year 8 months 3 weeks and 3 days-old red (white-faced) Hereford Heifer "Comet;" bred by himself.

‡LORD BATEMAN, of Shobdon Court, Leominster: for his 1 year 11 months 2 weeks and 2 days-old red (white-faced) Hereford Yearling Heifer "Vesta;" bred by himself.

‡Edward Price, of Court House, Pembridge: for his 1 year and 6 months-old red-and-white Hereford Yearling Heifer "Lorah;" bred by himself.
‡Edward Price, of Court House: for his 1 year and 7 months-old red-and-white Hereford Yearling Heifer "Gloucester;" bred by himself.
‡George Pitt, of Chadnor Court: for his 1 year 9 months and 3 days-old red (white-faced) Hereford Yearling Heifer; bred by himself.
†William Hole, Hannaford, Barnstaple, Devon: for his 2 years 8 months 2 weeks and 2 days-old red North Devon Bull "Zeluco;" bred by himself.
‡Thomas Webber, of Halberton Court, Tiverton: for his 3 years and 5 months-old red Devon Bull "Prince Albert;" bred by himself.
‡James Davy, of Flitton Barton, Southmolton: for his 2 years 2 months and 1 week-old red Devon Bull "Bampfylde;" bred by himself.
†His Royal Highness the Prince Consort: for his 1 year 8 months and 3 weeks-old red Devon Bull "Prince Arthur;" bred by himself.
†James Merson, of Brindsworthy, North Molton: for his red North Devon Bull "Portman;" bred by himself.
†James Quartly, of Molland House: for his 1 year 7 months and 2 days-old red North Devon Bull "Marquis of Salisbury;" bred by himself.
†James Davy, of Flitton Barton: for his 6 months 3 weeks and 6 days-old red Devon Bull-Calf "Poltimore;" bred by himself.
†George Turner, of Barton: for his 8 years and 2 months-old red Devon Cow, In-milk, "Heart's-ease;" bred by himself.
†James Merson, of Brinsworthy: for his 4 years and 10 months-old light-red North Devon Cow, In-milk and In-calf, "Lovely;" bred by Richard Merson, of Brinsworthy.
‡Abraham Umbers, of Weston Hall, Leamington-Spa, Warwick: for his 8 years 2 months 3 weeks and 4 days-old red North Devon Cow, In-milk and In-calf, "Splendid;" bred by himself.
‡James Davy, of Flitton Barton: for his 9 years 3 months and 3 weeks-old red Pure Devon Cow, In-milk and In-calf, "Curly;" bred by himself.
†James Davy, of Flitton Barton: for his 2 years and 10 months-old red Pure Devon Heifer, In-calf, "Princess of Prussia;" bred by himself.
†George Turner, of Barton: for his 1 year 8 months and 2 weeks-old red Devon Heifer, In-calf, "Lurline;" bred by himself.
†Rev. Robert Townshend Forester, of Elmley Lodge, Droitwich: for his 4 years 2 months 3 weeks and 4 days-old black-and-white Alderney Bull "Ercall Magna;" bred by himself.
‡Dryden Robert Corbet, of Sundorne Castle, Shrewsbury: for his 3 years 2 months and 12 days-old brown-and-white Ayrshire Bull "Colin;" bred by Alexander Wilson, Fore House, Kilbarchan, Paisley.
†Rev. Robert Townshend Forester, of Elmley Lodge: for his 6 years-old fawn (white muzzled, slightly smoky) Alderney Cow, In-calf, "Duchess."
‡Dryden Robert Corbet, of Sundorne Castle: for his 4 years 1 month and 3 weeks-old red-and-white Ayrshire Cow, In-milk, "Blooming Nell;" bred by the late A. W. Corbet, Sundorne Castle.
†Lord Sondes, of Elmham Hall, Thetford: for his 2 years 2 months and 2 weeks-old red Norfolk Polled Heifer, in-calf, "Zaidee;" bred by himself.
†Earl of Southesk, of Kinnaird Castle: for his 1 year 5 months and 3 days-old black Polled Angus Heifer "Vanilla;" bred by himself.
‡Thomas Waller, jun., of Mellor, Stockport: for his 2 years 2 months 4 weeks and 1 day-old roan Bull, adapted for Dairy purposes, "Free Trader:" bred by Edward Akroyd, Denton Park, Otley, York.
‡Richard Barton, of Caldy Manor, Birkenhead: for his 2 years 2 months 1 week and 3 days-old roan Short-horned Bull "East Cumberland;" bred by Mr. Relph, Fog Close, Kirkoswald, Penrith.
‡William Palin, of Stapleford Hall, Tarvin, Chester; for his pair of Cows best adapted for Dairy purposes, one 6 years 2 months and 2 weeks-old light roan, and one 5 years 2 months and 3 weeks-old red-and-white; both In-milk and both bred by himself.
†Llywelwyn Lewis, of the Bulkeley Arms, Aber, Carnarvon: for his 6 years 2 months and 3 weeks-old black Welsh Bull "Menrig;" bred by William Lewis, Fordd Deg, Beaumaris.

Sir Richard Bulkeley William Bulkeley, Bart., M.P., Baron Hill: for his 5 years and 2 weeks-old grey Welsh Cow, In-milk and In-calf, "Duchess;" bred by William Lloyd, Caebold, Carnarvon.

†Edmund Surtenham, of Caneyralyn, Wrexham: for his 6 years and 3 months-old black Welsh Cow, In-calf; bred by Ellis Jones, of Brynmeibion, Ruthin.

Horses.

†Thomas Crisp, of Butley Abbey: for his 3 years-old chesnut Agricultural Suffolk Stallion "Champion;" bred by James Read, Laxfield, Yoxford, Suffolk.

†William Wilson, of Baylham Hall, Ipswich: for his 3 years and 2 months-old chesnut Agricultural Suffolk Stallion "Salisbury Duke;" bred by Sir Edward Kerrison, M.P., of Oakley Park, Eye, Suffolk.

‡Alexander Begbie, of Lytham, Preston: for his 3 years and 2 weeks-old bay Agricultural Clydesdale Stallion "Sir Walter Scott;" bred by George Scott, Barr, Largs, Ayrshire.

‡Peter Nightingale, of Worsley, Manchester: for his 9 years-old grey Agricultural Stallion "King William;" bred by Mr. Gratrix, Irlam, Manchester.

†‡Thomas Crisp, of Rutley Abbey: for his 2 years-old chesnut Agricultural Suffolk Stallion "Emperor;" bred by J. G. Shephard, of Campsay Ashe, Woodbridge.

‡Edward Robinson, of Greenbank, Lymm, Warrington: for his 2 years 1 month and 3 days-old black Agricultural Cleveland Stallion "Monarch;" bred by himself.

‡William Wilson, of Baylham Hall, Ipswich: for his 2 years and 2 months-old chesnut Agricultural Suffolk Stallion; bred by the Rev. Mr. Reynolds, Debach, Woodbridge.

†William Taylor, of Curdley, Warrington: for his 6 years-old black Agricultural Cart Mare, with her foal; bred by himself.

‡William Etches, of Harley-Thorn, Newcastle-under-Lyme: for his 7 years-old bay Agricultural Cart Mare "Topsy," with her foal; bred by Eli Devil, Sharp Cliff, Cheadle, Staffordshire.

‡John Gurton Thompson, of Chilwell, Nottingham: for his 4 years and 2 months-old chesnut Agricultural Cart Mare "Brick," with her foal; bred by himself.

‡Thomas Crisp, of Butley Abbey: for his 9 years-old chesnut Agricultural Suffolk Mare "Dapper," with her foal; bred by Thomas Capron, of Dennington, Framlingham, Suffolk.

†Thomas Crisp, of Butley Abbey: for his 2 years-old chesnut agricultural Suffolk Filly "Jewel;" bred by himself.

‡John S. Crawley, of Stockwood, Luton, Bedford: for his 2 years 1 month 2 weeks and 4 days-old chesnut Agricultural Suffolk Filly "Missy;" bred by himself.

‡His Royal Highness the Prince Consort: for his 2 years 1 month and 2 weeks-old brown Agricultural Clydesdale Filly "Bessie;" bred by himself.

†William and Thomas Baker, of Bury Farm, Stapleford, Cambridge: for their 4 years 2 months 1 week and 3 days-old grey Cambridgeshire Dray Stallion "Young Matchless;" bred by John Wallis, of Haslingfield, Cambridge.

‡Samuel and Robert Spencer, of Flecknoe, Rugby: for their 7 years-old grey Dray Stallion "George the Second;" bred by Mr. Dodd, Byfield, Daventry, Northampton.

†John Kay Farnworth, of the Oak Farm, Alderley-Edge, Cheshire: for his 17 or 18 years-old bay Half-bred Mare "Miss Clarke," adapted for breeding hunters.

‡George Holmes, of Toll Gavel, Beverley: for his 4 years-old dark-bay Hunting Mare "Vanity," adapted for breeding hunters; bred by Mr. Maw, Burlington, York.

‡John Banks, of Hartington, Ashhorne, Derbyshire: for his 4 years and 1 week-old grey Agricultural Stallion "Young Champion;" bred by Mr. Clarke, of Cannick, Lincoln.

‡William Evans, of Bodysgallen, Conway, Carnarvon: for his 2 years 1 month

2 weeks and 4 days-old dark-grey Agricultural Cart Stallion "Cymro;" bred by himself.

‡RICHARD JONES, of Rhosebrenna, Hope, Flintshire: for his 2 years and 3 months-old black Agricultural Stallion "Farmer's Friend;" bred by himself.

‡JOSEPH WHITLOW, of Preston Brook, Cheshire: for his pair of grey Agricultural Horses, "Tinker" and "Boxer," 7 years and 3 years old; "Tinker" bred by himself, and "Boxer" bred by Ralph Wright, Moldsworth, Cheshire.

‡WILLIAM POVER, Elton Hall, Ince, Chester: for his 1 year 2 months 3 weeks and 4 days-old grey Agricultural Filly; bred by the late Mr. Smith, of Elton Hall, Ince.

JOHN HUXLEY, of King-street, Chester: for his 3 years-old grey Mountain Stallion Pony "Turpin."

LLYWELYN LEWIS, of Bulkeley Arms, Aber, Carnarvon: for his 2 years 1 month 2 weeks and 3 days-old dark-brown Mountain Pony Stallion "Llwytnor;" bred by himself.

MATTHEW FISH, of St. John Street, Chester: for his 3 years-old black Welsh Mountain Pony Stallion "Dick."

HON. COLONEL PENNANT, of Penrhyn Castle: for his 2 years-old bay Mountain Pony Stallion "Dandy;" bred by Mr. Templeton, of Penmaen Manor, Bangor.

THOMAS ROBERTS, of Bodedris, Llandeglor, Denbighshire: for his 3 years and (about) 2 months-old dark-brown Welsh Mountain Pony Stallion "Berwyn;" bred by himself.

JAMES DICKSON AND SONS, of Newton Nurseries, Chester: for their brown or mouse-coloured Mountain Pony Stallion "Tommy;" bred by Mr. Poundly, Karig, Newtown, Montgomeryshire.

‡THOMAS ROBERTS, of Bodedris: for his 4 years and (about) 3 months-old grey Welsh Mountain Mare Pony with her Foal; bred by himself.

‡WILLIAM PRITCHARD, of Sutton, near Preston-Brook: for his 3 years and 11 months-old brown Shetland Mountain Mare Pony "Jenny," with her Foal; bred by George Goodfellow.

‡TANAT WYNNE DENTON, of Newbold Lodge, Chester: for his 8 years and 3 months-old chestnut Welsh Mountain Mare Pony "Bess;" bred by Mr. Hughes, of Betton, Llanrwst.

‡ISAAC FAWKES, of Outertown, Annan: for his 1 year and 3 months-old dark-brown Colt "Sandy;" bred by James Pool, Croft Heads, Annan.

SHEEP.

‡THOMAS EDWARD PAWLETT, of Beeston: for his 16 months-old Leicester Shearling Ram; bred by himself.

‡JOHN BORTON, of Barton House, Malton, Yorkshire: for his 15 months-old Leicester Ram; bred by himself.

‡LIEUTENANT-COLONEL WILLIAM INGE, of Thorpe Constantine, Tamworth: for his 1 year and 4 months-old Pure Leicester Ram; bred by himself.

†ROBERT WARD CRESWELL, of Ravenstone: for his 3 years and 4 months-old Leicester Ram; bred by himself.

‡THOMAS EDWARD PAWLETT, of Beeston: for his 2 years and 4 months-old Leicester Ram; bred by himself.

‡SAMUEL UMBERS, of Wappenbury, Leamington; for his 3 years and 4 months-old Leicester Ram "Symmetry;" bred by himself.

‡JOHN BORTON, of Barton House: for his 39 months-old Leicester Ram; bred by himself.

‡GEORGE TURNER, of Barton: for his 2 years and 4-months-old Leicester Ram; bred by himself.

†THE DUKE OF RICHMOND, of Goodwood: for his 1 year and 4 months-old pen of five Shearling Southdown Ewes: bred by himself.

†THOMAS PORTER, of Baunton, Cirencester: for his 1 year and 4 months-old Shearling Cotswold Ram; bred by himself.

†ROBERT GARNE, of Aldsworth: for his 1 year 4 months and 1 week old Shearling Cotswold Ram; bred by the late William Garne, of Holdsworth.

‡GEORGE FLETCHER, of Shipton-Sollars, Andoversford, Cheltenham: for his 1 year and 4 months-old white Shearling Cotswold Ram; bred by himself.

‡Thomas Porter, of Baunton: for his 1 year and 3 months-old Shearling Cotswold Ram; bred by himself.
‡William Hewer, of Hill House: for his 1 year and 4 months-old Shearling Cotswold Ram; bred by himself.
†George Fletcher, of Skipton Sollars, Andoversford: for his 3 years and 4 months-old white Cotswold Ram; bred by himself.
‡Thomas Beale Browne, of Hampen, Andoversford: for his 2 years 3 months and 2 weeks-old white Cotswold Ram; bred by himself.
‡William Lane, of Broadfield Farm: for his 3 years 4 months and 1 week-old Long-Woolled Cotswold Ram; bred by himself.
‡Thomas Walker, Yanworth, Northleach: for his 1 year 3 months and 2 weeks-old pen of five Shearling Cotswold Ewes; bred by himself.
‡George Fletcher, of Shipton Sollars, Andoversford: for his 1 year and 4 months-old pen of five white Shearling Cotswold Ewes; bred by himself.
‡Thomas Beale Browne, of Hampen: for his 1 year 3 months and 2 weeks-old pen of five white Shearling Cotswold Ewes; bred by himself.
‡William Lane, of Broadfield Farm: for his 1 year 4 months and 1 week-old pen of five Shearling Long-Woolled Cotswold Ewes; bred by himself.
†William Humfrey, of Oak Ash: for his 1 year 3 months and 1 week-old dark-brown West Devon Ram; bred by himself.
‡James and Edward Crane, of Shrawardine: for their 1 year 3 months and 2 weeks-old Shropshire Ram; bred by themselves.
‡James and Edward Crane, of Shrawardine: for their 1 year 3 months and 2 days-old Shropshire Ram; bred by themselves.
‡John Bryan, of Southleigh, Witney: for his 1 year and 3 months-old Oxfordshire Down Ram; bred by himself.
‡William Orme Foster, of Kinver Hill Farm: for his 1 year 3 months and 2 weeks-old Shropshire Down Ram, with brown face and legs; bred by himself.
‡William Humfrey, of Oak Ash: for his 1 year and 5 months-old dark West Country Down Ram; bred by himself.
†John Bryan, of Southleigh: for his 4 years 3 months and 2 weeks-old Oxfordshire Down Ram; bred by himself.
†William Humfrey, of Oak Ash: for his 4 years 5 months and 3 weeks-old dark West Country Down Ram; bred by himself.
‡John Washbourne Browne, of Uffcott, Swindon: for his 2 years and 5 months-old Hampshire Down Ram; bred by himself.
‡George Mackenzie Kettle, of Dallicolt House, Bridgnorth: for his 2 years and (under) 4 months-old Shropshire Down Ram; bred by himself.
‡William Humfrey, of Oak Ash: for his 2 years 4 months and 1 week-old brown West Country Down Ram; bred by himself.
‡William Humfrey, of Oak Ash: for his 4 years 3 months and 1 week-old brown West Country Down Ram; bred by himself.
†James and Edward Crane, of Shrawardine: for their 1 year 3 months and 2 weeks-old pen of five Shearling Shropshire Ewes; bred by themselves.
†William Humfrey, of Oak Ash: for his 1 year 4 months and 2 weeks-old dark-brown pen of five Shearling West Country Down Ewes; bred by himself.
‡James and Edward Crane, of Shrawardine; for their 1 year and 3 months-old pen of five Shearling Shropshire Ewes; bred by themselves.
‡Edward Holland, of Dumbleton Hall, near Evesham: for his 1 year 3 months and 2 weeks-old Pen of five Shearling Shropshire Down Ewes; bred by himself.
‡Thomas Horton, of Harnage Grange, Shrewsbury: for his 2 years 2 months and 3 weeks-old original Shropshire Down Ram; bred by himself.
‡Thomas Horton, of Harnage Grange: for his 2 years 3 months and 2 weeks-old original Shropshire Down Ram; bred by himself.
‡Thomas Mansell, of Adcott Hall, Shrewsbury: for his 1 year and 4 months-old Pen of five Shearling Shropshire Down Ewes; bred by himself.
‡Hon. Colonel Pennant, of Penrhyn Castle: for his 1 year 2 months and 2 weeks-old Pen of five Shearling Cheviot Ewes; bred by Thomas Elliot, of Hindhope, Jedburgh.
‡Henry Robertson Sandbach, of Hafodunos: for his Pen of Cheviot Ewes, 5 years

2 months and 2 weeks-old. 4 years 2 months aad 2 weeks-old, and 3 years 2 months and 2 weeks-old; bred by himself.

‡HENRY ROBERTSON SANDBACH, of Hafodunos: for his Pen of Cheviot Ewes, 5 years 2 months and 2 weeks-old, 4 years 2 months and 2 weeks-old, and 3 years 2 months and 2 weeks-old; bred by himself.

‡GEORGE MACKENZIE KETTLE, of Dallicott House: for his from 2 years-old and upwards Pen of five Shropshire Down Ewes; bred by himself.

PIGS.

†JOHN HARRISON, JUN., of Heaton Norris: for his 1 year 10 months and 1 week-old white (spotted) Boar "Young Nelson," of a large breed; bred by Mr. Carswell, of Park House, Butley, Macclesfield.

‡THOMAS MARTINSON RICHARDSON, of Fibaldston Grange, Kirton-in-Lindsay: for his 4 years 11 months and 2 weeks-old white Boar "Eclipse," of a large breed; bred by the Earl of Fitzwilliam, Wentworth House, Rotherham.

†JOHN HARRISON, JUN., of Heaton Norris: for his 1 year 9 months and 1 week-old white Boar "Young Blucher," of a small breed; bred by himself.

‡THOMAS BARKER, of Leeds; for his 1 year 10 months and 3 weeks-old pure white Boar "Sir Colin," of a small breed; bred by John Seagrave, Oatlands Row, Meanwood-road, Leeds.

‡PHILIP STAPLETON HUMBERSTON, of Mollington, Chester: for his 9 months 1 week and 4 days-old white Boar, of a small breed; bred by Mrs. Humberston, of Newton Hall, Chester.

‡THOMAS CRISP, of Butley Abbey: for his 1 year 1 month and 2 weeks-old Improved black-breed Boar "Sepoy;" bred by himself.

‡EARL OF RADNOR, of Coleshill House: for his 8 months and 2 weeks-old white Coleshill Boar "Chester;" bred by himself.

SAMUEL WOODHOUSE, of Norley Hall, Frodsham, Chester: for his 1 year 3 months and 3 weeks-old white Boar "Ben," of a small breed; bred by Edward Fullard, of Clifton Park, Birkenhead.

JOHN DAWSON, of Gronant, Rhyl: for his 6 months 1 week and 4 days-old white Yorkshire Improved small-breed Boar; bred by himself.

GEORGE MANGLES, of Givendale, Ripon: for his 1 year 9 months 2 weeks and 3 days-old white Yorkshire and Cumberland Improved small-breed Boar "Shylock;" bred by himself.

GEORGE MANGLES: for his 1 year 2 months 3 weeks and 4 days-old Yorkshire and Cumberland Improved Boar "Samson;" bred by Mark Barroby, of Dishforth, Yorkshire.

CHARLES HOLLAND, of Keele, Newcastle, Staffs: for his 1 year and 7 months-old white Boar of a small breed; bred by the Duke of Sutherland, Trentham, Newcastle, Staffs.

GEORGE TURNER, of Barton: for his 1 year 11 months and 3 days-old black Improved Essex Boar; bred by himself.

GEORGE TURNER: for his 10 months and 2 weeks-old black Improved Essex Boar; bred by himself.

EDWARD UMBERS, of Wappenbury, Leamington: for his 1 year 11 months and 10 days-old white Yorkshire small breed Boar; bred by Samuel Wiley, of Brandsby, York.

JOSEPH HINDSON, of Barton House, Everton, Liverpool: for his 11 months 3 weeks and 4 days-old white Pure small breed Boar "Chieftain;" bred by himself.

THOMAS BARKER, of Brown's Yard, Leeds: for his 1 year 4 months and 17 days-old white Pure small breed Boar "Cupid the 3rd;" bred by William Hatton, of Addingham, near Ilkley, Yorkshire.

THOMAS CRISP, of Butley Abbey: for his 1 year and 8 months-old white Suffolk Boar "Sausage;" bred by himself.

EDGAR MUSGROVE, of Aughton, Ormskirk: for his 1 year 1 month and 1 week-old white Pure small breed Boar "Chancellor;" bred by Joseph Hindson, of Barton House, Everton.

WILLIAM ADAMS, of Leighton Cottage, Spring-street, Birmingham: for his 1 year and 8 months-old white Cumberland Boar "Duke the 4th;" bred by John Edward Clift, of King's Norton, Worcester.

Samuel Druce, of Eynsham, Oxford: for his 10 months 2 weeks and 2 days-old black Improved Oxfordshire Boar; bred by himself.

Henry Scott Hayward, of Folkington, Wellingdon, Sussex: for his 3 years-old white Boar "Tom;" bred by himself.

William Ancell, of 7, Cumberland-street, Manchester: for his 6 months 1 week and 4 days-old white (blue-skinned) Pure small breed Boar "Little John;" bred by himself.

Lieut.-Colonel Charles Towneley: for his (about) 10 months-old white small-breed Boar "Nimrod;" bred by himself.

John Fenn, of Dry Drayton, Cambridge: for his 6 months 4 weeks and 1 day-old Improved Coleshill small-breed Boar; bred by George Bayliss, Coleshill, Highworth, Wilts.

Joseph Wilkinson, of Roundhay, near Leeds: for his 2 years and 10 months-old white (spotted) small-breed Boar "Young Prince;" bred by Mr. Downs, Reddish, Lancashire.

Edward Williams, of Celyn, Northorp, Flints: for his 2 years and 8 months-old small-breed Boar "Northopion;" bred by himself.

*Joseph Wilkinson, of Roundhay, near Leeds: for his 2 years and 1 week-old blue-and-white Sow "Mary Ann," of a large breed; bred by himself.

†William Bradley Wainman, of Carhead, Cross Hills, Yorkshire: for his 3 years 6 months and 3 weeks-old white Improved Yorkshire Breeding-Sow "Chester Duchess," of a large breed; bred by himself.

†Joseph Tuley, of Truewell Farm, Keighley, Yorkshire: for his 4 years 1 month 3 weeks and 6 days-old white Breeding-Sow "Florence Nightingale," of a large breed; bred by Joseph Blan, of Keighley.

‡Peter Wright, of Minshull, Church Minshull, Cheshire: for his 1 year 3 months 1 week and 5 days-old white Breeding-Sow, of a large breed; bred by himself.

‡James Clayton, of Midway Farm, Poynton, near Stockport: for his 2 years 8 months 2 weeks and 5 days-old blue-and-white Breeding-Sow "Miss Carswell," of a large breed; bred by Allan Carswell, of Park House, Butley, near Macclesfield.

‡Edward Bowly, of Siddington House, Cirencester: for his 1 year 2 months and 2 weeks-old black (with a little white) Improved Berkshire Breeding-Sow; bred by himself.

‡John Palmer, of Thorlby, Skipton, for his 1 year and 11 months-old white Breeding-Sow "Victoria 2nd," of a large breed; bred by himself.

*Thomas Crisp, of Butley Abbey: for his 1 year and 9 months-old white Suffolk Breeding-Sow "Pearl;" bred by himself.

†Lieutenant-Colonel Towneley: for his 1 year 1 month 3 weeks and 2 days-old white Breeding-Sow "Model," of a small breed; bred by himself.

‡Robert Harrison Watson, of Bolton Park, Wigton, Cumberland: for his 3 years 6 months and 5 days-old white Breeding-Sow "Fortunate," of a small breed; bred by himself.

‡George Mangles, of Givendale: for his 1 year 7 months 1 week and 3 days-old white Yorkshire and Cumberland Improved Breeding-Sow "Princess Royal;" bred by himself.

‡John Harrison, Jun., of Heaton Norris: for his 2 years and 2 months-old white Breeding-Sow "Matchless," of a small breed; bred by himself.

‡Thomas Crisp, of Butley Abbey: for his 3 years and 2 weeks-old black Improved small breed Breeding-Sow "Blackbird;" bred by himself.

‡John Palmer, of Thorlby, Skipton: for his 3 years and 1 month-old white Breeding-Sow "Favorite," of a small breed; bred by Lieutenant-Colonel Towneley.

‡Joseph Wilkinson, of Roundhay, near Leeds: for his 2 years 1 month and 1 week-old white Breeding-Sow "Jenny," of a small breed; bred by himself.

Hon. Colonel Pennant, of Penrhyn Castle: for his 4 years 2 months and 1 week-old white Breeding-Sow "Testy," of a small breed; bred by himself.

John Dawson, of Gronant, Rhyl: for his 7 months 1 week and 1 day-old white Yorkshire Improved small-breed Sow; bred by himself.

Edmund Wright, of Halston, Oswestry: for his 2 years and 8 months-old black Breeding-Sow "Polly," of a small breed; bred by himself.

George Mangles, of Givendale: for his 1 year 9 months 2 weeks and 4 days-old white Yorkshire and Cumberland Breeding-Sow "Snowdrop," of a small breed; bred by himself.

George Mangles: for his 3 years 4 months and 1 week-old white Yorkshire and Cumberland Breeding-Sow "Buttercup," of a small breed; bred by himself.

George Mangles; for his 3 years 4 months and 1 week-old white Yorkshire and Cumberland Breeding-Sow "Bracelet," of a small breed; bred by himself.

George Turner, of Barton: for his 1 year 9 months and 2 weeks-old black Improved-Essex Breeding-Sow, of a small breed; bred by himself.

George Turner: for his 10 months and 2 weeks-old black Improved-Essex Breeding-Sow, of a small breed; bred by himself.

Edward Umbers, of Wappenbury: for his 2 years 2 weeks and 4 days-old white Yorkshire Breeding-Sow, of a small breed; bred by Lieutenant-Colonel Pennant, of Penrhyn Castle.

Joseph Hindson, of Barton House, Everton: for his 2 years and 2 months-old black Improved-Essex Breeding-Sow "Indian Queen," of a small breed; bred by himself.

Samuel Munro, of 19, East Stanley-street, Salford: for his 3 years 1 week and 3 days-old white Breeding-Sow "Molly," of a small breed; bred by himself.

Samuel Munro: for his 1 year and 7 months-old white Breeding-Sow "White Rose," of a small breed; bred by himself.

Thomas Crisp, of Butley Abbey: for his 3 years and 2 weeks-old Improved small Black-breed Sow "Wonder;" bred by himself.

Thomas Crisp: for his 1 year 1 month and 2 weeks old Improved small Black-breed Sow "Blackberry;" bred by himself.

Samuel Druce, of Eynsham: for his 1 year 11 months 2 weeks and 4 days-old black Improved Oxfordshire Sow, of a small breed; bred by himself.

Henry Scott Hayward, of Folkington, Willingdon: for his 2 years 1 month 1 week and 4 days-old white Breeding-Sow "Queen of the Downs," of a small breed; bred by himself.

Charles Holland, of Keele: for his 18 months-old white Breeding-Sow, of a small breed; bred by the Duke of Sutherland, of Trentham.

Charles Holland: for his 18 months-old black Breeding-Sow, of a small breed; bred by himself.

William Ancell, of 7, Cumberland-street, Manchester: for his 1 year 7 months and 4 days-old white "small breed" Sow "Bess;" bred by Robert Crossley, of Siverton Place, Consterdine-street, Manchester.

George Hutchinson, of Prospect House, York: for his 3 years and 3 weeks-old white Yorkshire Breeding Sow "Miss Moor," of a small breed; bred by Josh. Braddock, of the Gas Works, York.

Lieutenant-Colonel Towneley: for his 10 months and 2 days-old white Breeding-Sow "Nicaty," of a small breed; bred by himself.

Solomon Ashton, of 20, Peter-street, Manchester: for his 1 year and 6 months-old white "pure small breed" Breeding-Sow "Matchless;" bred by himself.

Joseph Wilkinson, of Roundhay, near Leeds: for his 1 year 1 month and 3 weeks-old white Breeding-Sow "Daisy," of a small breed; bred by himself.

[The Judges state this to be a Class of extraordinary merit.]

‡William James Sadler, of Bentham, Calcutt, Cricklade: for his 7 months and 3 days-old Pen of three Berkshire Breeding-Sow Pigs, of a large breed; bred by himself.

*Robert Harrison Watson, of Bolton Park, Wigton: for his 7 months 2 weeks and 3 days-old Pen of three white Breeding-Sow Pigs "Are," "We," "Good," of a small breed; bred by himself.

†Robert Harrison Watson: for his 6 months and 3 weeks-old Pen of three white Breeding-Sow Pigs "Faith," "Hope," and "Charity," of a small breed; bred by himself.

‡Hon. Colonel Pennant, of Penrhyn Castle: for his 4 months and 9 days-old Pen of three white Breeding-Sow Pigs "May," "Rose," and "Lily," of a small breed; bred by himself.

‡Joseph Hindson, of Barton House, for his 2 years 11 months and 2 weeks-old "small breed" white Sow "Polyanthus;" bred by Henry Scott Hayward, Folkington, Willingdon, Sussex.

IMPLEMENTS.

John Fowler, Jun., of 28, Cornhill, London: the Prize of Five Hundred Sovereigns, for his Steam-Plough, invented by himself, and manufactured by Robert Stephenson and Co., of Newcastle-on-Tyne, and Ransomes and Sims, of Ipswich.

Richard Hornsby and Sons, of Spittlegate Iron Works, Grantham: the Prize of Twenty-Five Sovereigns, for their 12-Horse-power Portable Steam-Engine; invented, improved, and manufactured by themselves.

Tuxford and Sons, of Boston and Skirbeck Iron Works, near Boston: the Prize of Twenty-five Sovereigns, for their 8-Horse-power Portable Steam-Engine; invented by Weston Tuxford, of Boston, and manufactured by the Exhibitors.

Clayton, Shuttleworth, and Co., of Lincoln: the Prize of Ten Sovereigns, for their 8-Horse-power Portable Steam-Engine; invented, improved, and manufactured by themselves.

Barrett, Exall, and Andrewes, of Reading: the Prize of Twenty Sovereigns, for their 10-Horse-power Horizontal Fixed Steam-Engine; invented, improved, and manufactured by themselves.

Richard Hornsby and Sons: the Prize of Ten Sovereigns, for their 8-Horse-power Horizontal Fixed Steam-Engine; invented, improved, and manufactured by themselves.

Ransomes and Sims, of Ipswich: the Prize of Ten Sovereigns, for their 10-Horse-power Steam-Boiler, for a Fixed Engine; invented by Biddell and Balk, of Ipswich, and manufactured by the Exhibitors.

Richard Garrett and Sons, of Leiston Works, Saxmundham: the Prize of Ten Sovereigns, for their 5-Horse-power Portable Bolting, Thrashing, and Straw-Shaking Machine; invented, improved, and manufactured by themselves.

Clayton, Shuttleworth, and Co.: the Prize of Fifteen Sovereigns, for their Combined Portable Thrashing, Shaking, and Riddling Machine; invented, improved, and manufactured by themselves.

Clayton, Shuttleworth, and Co.: the Prize of Fifteen Sovereigns, for their Combined Single Blower Finishing Machine; invented, improved, and manufactured by themselves.

Clayton, Shuttleworth, and Co.: the Prize of Fifteen Sovereigns, for their Combined Double Blower Finishing Machine; invented, improved, and manufactured by themselves.

Richard Hornsby and Sons: the Prize of Twenty Sovereigns, for their Improved 10-Horse-power Fixture Combined Thrashing, Shaking, and Dressing Machine, for preparing Corn for Market; invented, improved, and manufactured by themselves.

Clayton, Shuttleworth, and Co.: the Prize of Ten Sovereigns, for their Combined Fixed Double Blower Finishing Machine; invented, improved, and manufactured by themselves.

Richard Hornsby and Sons: the Prize of Five Sovereigns, for their Corn Dressing or Winnowing Machine; invented, improved, and manufactured by themselves.

Richard Garrett and Sons: the Prize of Five Sovereigns, for their Improved Corn Dressing Machine; invented, improved, and manufactured by themselves.

Robert Boby, of Bury St. Edmunds: the Prize of Three Sovereigns, for his Large Corn Screen; invented by T. C. Bridgman, of Bury St. Edmunds; improved and manufactured by the Exhibitor.

James Cornes, of Barbridge, near Nantwich: the Prize of Five Sovereigns, for his Registered Chaff-cutting Machine (No. 5), with Three Knives; invented by John Cornes, sen., of Barbridge, improved and manufactured by the Exhibitor.

Bernard Samuelson of Banbury: the Prize of Three Sovereigns, for his Improved Cornes' Chaff-cutter (K. 10); invented by John Cornes, sen., of Barbridge, improved and manufactured by the Exhibitor.

Ransomes and Sims: the Prize of Three Sovereigns, for their Biddell's Chaff-cutter (No. 3); invented and improved by G. A. Biddell, of Ipswich, and manufactured by the Exhibitor.

Richmond and Chandler, of Salford: the Prize of Two Sovereigns, for their Royal Agricultural Society of England Prize Chaff-cutting Machine (No. 3); invented, improved, and manufactured by themselves.

Richard Garrett and Sons: the Prize of Ten Sovereigns, for their Portable Stone Grinding-Mill; improved and manufactured by themselves.

Ransomes and Sims: the Prize of Five Sovereigns, for their Bruising-Mill (No. 6), on an Iron Stand; manufactured by themselves.

Edward Hammond Bentall, of Heybridge, near Maldon: the Prize of Five Sovereigns, for his New Oil-cake Mill (marked O C C); invented, improved, and manufactured by himself.

William Newzam Nicholson, of Newark-upon-Trent: the Prize of Three Sovereigns, for his Machine for breaking Oil-cake for Beasts and Sheep; invented, improved, and manufactured by himself.

Alfred Crosskill (for the trustees of W. Crosskill), of Beverley: the Prize of Ten Sovereigns, for his Improved Bone-Mill, for Steam or Water Power; improved and manufactured by himself.

Alfred Crosskill: the Prize of Five Sovereigns, for his Bone Dust-Mill; invented, improved, and manufactured by himself.

Ransomes and Sims: the Prize of Three Sovereigns, for their Biddell's Root-cutter (No. 22 L); invented by G. A. Biddell, of Ipswich, and manufactured by the Exhibitors.

Bernard Samuelson: the Prize of Three Sovereigns, for his Gardner's Turnip-cutter (double action); invented by the late James Gardner, of Banbury, improved and manufactured by the Exhibitor.

Edward Hammond Bentall: the Prize of Three Sovereigns, for his Prize Root Pulper (marked R P A); invented, improved, and manufactured by himself.

Burgess and Key, of 95, Newgate-Street, London: the Prize of Three Sovereigns, for their American Churn; invented by C. J. Anthony, of America; improved and manufactured by the Exhibitors.

T. F. Griffiths and Co., of Birmingham: the Prize of Three Sovereigns, for their Keevill's Cheesemaking Apparatus; invented by Richard Keevill, of Lacock, Wilts, and manufactured by the Exhibitors.

Hugh Carson, of Warminster: the Prize of Three Sovereigns, for his Single Cheese-Press (No. 2); invented, improved, and manufactured by himself.

MEDALS.

William Woofe, of Regent-Street, Gloucester: a Silver Medal, for his Paring Plough; invented and manufactured by himself.

Robert and John Reeves, of Bratton, near Westbury, Wilts: a Silver Medal, for their Cheese-making Apparatus; invented, improved, and manufactured by Edward Cockey and Sons, of Frome Selwood.

Priest and Woolnough, of Kingston-on-Thames: a Silver Medal, for their Rowley's Blast Drill; invented by J. Jephson Rowley, of Rowthorn, near Chesterfield, and improved and manufactured by the Exhibitors.

E. Page and Co., of Bedford: a Silver Medal, for their Improved Draining-Pipe and Tile-Machine (No. 4); invented by William Williams, of Bedford, and manufactured by the Exhibitors.

Burgess and Key, of 95, Newgate-Street: a Silver Medal, for their Chronometrical Thermometer; invented by W. H. Gauntlett, of South Bank Iron Works, Middlesboro'-on-Tees.

George Turner, of 196, Great Dover-Street, Borough, London: a Silver Medal, for his Whisk for Eggs; invented by E. P. Griffiths, of London: improved by George Kent, of London, and manufactured by the Exhibitor.

Commendations.

The mark * signifies "highly commended;" and the mark † "commended."

*E. Page and Co.: for their Three-knife Chaff-Engine; manufactured by themselves.

*Richard Garrett and Sons: for their Improved Corn-Dressing Machine for preparing all kinds of grain for market; invented, improved, and manufactured by themselves.

*Robert Roby: for his Corn-Dressing Machine: invented by T. C. Bridgman, of Bury St. Edmunds; improved and manufactured by the Exhibitor.

*E. A. Ferryman, of Wadenhoe, near Oundle: for his Churn: invented by the Exhibitor, and manufactured by J. Gann, of Oundle.

*Hugh Carson, of Warminster: for his Chaff-cutting Engine for Steam or Horse-power (No. 1 a); invented, improved, and manufactured by himself.

*Ransomes and Sims: for their Portable 5-Horse power Thrashing Machine, on four wheels, with Brinsmead's Patent Shakers; invented, improved, and manufactured by themselves.

Richard Hornsby and Son: for their Double Cake Breaking or Crushing Machine; invented, improved, and manufactured by themselves.

*William Newzam Nicholson: for his Machine for Breaking Oil-cake for Beasts and Sheep, and Rape-cake for Tillage; invented, improved, and manufactured by himself.

*Smith and Ashby, of Stamford, Lincolnshire: for their Registered Oil-cake Mill, with Double-action for Sheep and Oxen; invented, improved, and manufactured by themselves.

*Ransomes and Sims: for their 12-Horse power Double Cylinder Portable Steam-Engine; manufactured by themselves.

*Tuxford and Sons: for their 12-horse power Portable Steam-Engine, with two Vertical Cylinders, within a Steam Jacket; invented by Weston Tuxford, of Boston, manufactured by the Exhibitors.

*Clayton, Shuttleworth, and Co.: for their 12-Horse power Portable Double Cylinder Steam-Engine, with Patent Fire-box; invented, improved, and manufactured by themselves.

*Richard Hornsby and Sons: for their 8-Horse power Portable Steam-Engine; invented, improved, and manufactured by themselves.

*George Howe, of Farningham, near Dartford, Kent: for his 10-Horse power Tubular Boiler for Fixed Steam-Engine; invented, improved, and manufactured by himself.

*Picksley, Sims, and Co., of Bedford Foundry, Leigh, near Manchester: for their Improved Turnip Cutter; invented and manufactured by themselves.

*Robert Boby: for his Adjusting Corn Screen; invented by T. C. Bridgman, of Bury St. Edmunds, improved and manufactured by the Exhibitor.

*Wallis and Haslam, of Basingstoke, Hants: for their Spherical Plummer Block and Bearings; invented by themselves.

*Hill and Smith, of Brierley Hill Iron Works, near Dudley, Staffordshire: for their General Assortment of Iron Hurdles and Gates; manufactured by themselves.

*Ransomes and Sims: for their Flour Mill, with 3-feet Stones, on an Iron Stand; invented, improved, and manufactured by themselves.

*Thomas Stapleton, of Dock Office Row, Hull: for his Portable or Travelling Corn-Grinding Mill; invented, improved, and manufactured by John Tye, of Lincoln.

*Richard Hornsby and Sons: for their Improved Portable Combined Thrashing, Shaking, and Dressing Machine, for Preparing Corn for the Market; invented, improved, and manufactured by themselves.

†William Newzam Nicholson: for his Corn Winnowing, Roughing, and Blowing Machine; invented, improved, and manufactured by himself.

†Barrett, Exall, and Andrews: for their O. F. Safety Chaff-cutter, for Steam or Water-power; invented, improved, and manufactured by themselves.

†Ransomes and Sims: for their Portable 5-Horse power Thrashing Machine, on four wheels, with Brinsmead's Patent Shakers; invented, improved, and manufactured by themselves.

†W. L. Fisher, of Thrapston, Northamptonshire: for his Improved Double Cake Mill; invented and improved by Nathaniel Smith, of Thrapston, and manufactured by the Exhibitor.

†Edward Hammond Bentall: for his Improved Prize Oil-cake Mill (marked O C A); invented, improved, and manufactured by himself.

†Arthur Silcock, of Chippenham, Wilts: for his Single Cheese-press, with Compound Lever; improved and manufactured by himself.

†William Brown and Charles N. May, of Devizes: for their 8-Horse power Portable Steam-Engine; manufactured by themselves.

†Ransomes and Sims, of Ipswich: for their 8-Horse power Portable Steam-Engine; manufactured by themselves.

†James Woods and Son, of The Suffolk Iron Works, Stowmarket: for their Pair of Wheels, and Improved Boxes and Axles; invented, improved, and manufactured by themselves.

†Clayton, Shuttleworth, and Co.: for their Portable Mill for Steam Power; invented, improved, and manufactured by themselves.

†Ransomes and Sims: for their Portable Combined Double-blast Steam Thrashing-Machine (marked A 1); invented, improved, and manufactured by themselves.

†E. and T. Humphries of Pershore, Worcestershire: for their Portable Combined Thrashing, Straw-shaking, Riddling, Winnowing, Barley-horning, and Sacking Machine; invented, improved, and manufactured by themselves.

CHEESE.

George Willis, of Ridley Hall, Tarporley: the Champion Prize of One Hundred Sovereigns, for his Four Cheeses, weighing not less than 60 lbs. each; made in 1857.

Robert Bostock Ankers, of Huxley Green, Huxley, Cheshire: the Prize of Thirty Sovereigns, for his Four Coloured Cheeses, weighing not less than 60 lbs. each; made in 1857.

John Byram, of Pool Farm, Overpool, Eastham, Cheshire: the Prize of Twenty Sovereigns, for his Four Coloured Cheeses, weighing not less than 60 lbs. each; made in 1857.

Charles Beresford, of Elton, Sandbach: the Prize of Twenty Sovereigns, for his Four Coloured Cheeses, weighing not less than 40 lbs. each; made in 1857.

Edward Harrison Martin, of Bar Hill House, Madeley, Staffs; the Prize of Fifteen Sovereigns, for his Four Coloured Cheeses, weighing not less than 40 lbs. each; made in 1857.

John Churton, of Barrel Well House, near Chester: the Prize of Fifteen Sovereigns, for his Four Coloured Cheeses, weighing under 40 lbs. each; made in 1857.

Jonathan Gresty, of Thurlwood Farm, Betchton, near Lawton, Cheshire: the Prize of Ten Sovereigns, for his Four Coloured Cheeses, weighing under 40 lbs. each; made in 1857.

John Hartshorn, of Eccleston Hill, near Chester: the Prize of Thirty Sovereigns, for his Four Uncoloured Cheeses, weighing not less than 50 lbs. each; made in 1857.

Robert Bostock Ankers: the Prize of Twenty Sovereigns, for his Four Uncoloured Cheeses, weighing not less than 50 lbs. each; made in 1857.

Philip Acton Wood, of Oak House, near Over and Winsford, Cheshire: the Prize of Twenty Sovereigns, for his Four Uncoloured Cheeses, weighing under 50 lbs. each; made in 1857.

Jonathan Gresty: the Prize of Fifteen Sovereigns, for his Four Uncoloured Cheeses, weighing under 50 lbs. each: made in 1857.

George Jackson, of Withington, near Congleton, Cheshire: the Prize of Twenty Sovereigns, for his Four Uncoloured Cheeses, weighing not less than 60 lbs. each; made in 1858.

James Cookson, of Utkinton, near Tarporley: the Prize of Fifteen Sovereigns, for his Four Coloured Cheeses, weighing not less than 60 lbs. each; made in 1858.

Philip Acton Wood: the Prize of Fifteen Sovereigns, for his Four Coloured Cheeses, weighing not less than 40 lbs. and under 60 lbs. each; made in 1858.

John Churton: the Prize of Ten Sovereigns, for his Four Coloured Cheeses, weighing not less than 40 lbs. and under 60 lbs. each; made in 1858.

Jonathan Gresty: the Prize of Ten Sovereigns, for his Four Uncoloured Cheeses, weighing under 40 lbs. each; made in 1858.

William Acton, of Appleton, near Warrington: the Prize of Five Sovereigns, for his Four Uncoloured Cheeses, weighing under 40 lbs. each; made in 1858.

Commendations.

The mark * signifies "highly commended," and the mark † "commended."

*Joseph Salmon, of Hatton, near Waveton, Cheshire: for his Four Coloured Cheeses, weighing under 40 lbs. each; made in 1857.

*Thomas Dutton, of Brindley, near Nantwich, Cheshire: for his Four Coloured Cheeses, weighing under 40 lbs. each; made in 1857.

†Hugh Bennett Briscoe, of Littleton, near Chester: for his Four Coloured Cheeses, weighing under 40 lbs. each; made in 1857.

†James Cookson: for his Four Coloured Cheeses, weighing under 40 lbs. each; made in 1857.

†Nathaniel Tomlinson, of Calverley, near Tarporley: for his Four Coloured Cheeses, weighing under 40 lbs. each; made in 1857.

*John Byram: for his Four Uncoloured Cheeses, weighing under 50 lbs. each; made in 1857.

*Mary Wrench, of Huntington, near Chester: for her Four Uncoloured Cheeses, weighing under 50 lbs. each; made in 1857.

†John Churton: for his Four Uncoloured Cheeses, weighing under 50 lbs. each, made in 1857.

†William Palin, of Stapleford Hall, near Tarvin, Cheshire: for his Four Uncoloured Cheeses, weighing under 50 lbs. each: made in 1857.

†Thomas Lowe, of Calverley Hall, near Handley, Cheshire: for his Four Uncoloured Cheeses, weighing under 50 lbs. each; made in 1857.

†Josiah Whitlow, of Huxley Hall, near Chester: for his Four Coloured Cheeses, weighing not less than 60 lbs. each; made in 1858.

†John Lowe, of Golborn Daviel, near Chester: for his Four Coloured Cheeses, weighing not less than 60 lbs. each; made in 1858.

†Thomas Taylor, of Overton Hall, Malpas, Cheshire: for his Four Coloured Cheeses, weighing not less than 60 lbs. each; made in 1858.

†Mary Wrench: for her Four Coloured Cheeses, weighing not less than 60 lbs. each; made in 1858.

BUTTER.

Viscount Combermere, of Combermere Abbey, Nantwich: the Prize of Ten Sovereigns for his Crock of Butter, weighing not less than 20 lbs.

William Jones, of Tron Wen, Llangerniew, Denbigh: the Prize of Five Sovereigns, for his Crock of Butter, weighing not less than 20 lbs.

Essays and Reports.—PRIZES FOR 1859.—All Prizes of the Royal Agricultural Society of England are open to general competition. Competitors will be expected to consider and discuss the heads enumerated.

I. MICROSCOPIC INVESTIGATION.

Fifty Sovereigns will be given for the best Report on the Results of Microscopic Observation applied to the Vegetable Physiology of Agriculture.

It is not thought desirable to confine the observer too strictly to any particular line of research, the only necessary limitation being, that the plants to be examined and reported upon shall be selected from those commonly cultivated; such as the *cereals*, or those usually known under the names of *pulse*, *root*, and *fodder* crops. The structural formation of these plants—their ordinary vital processes —modifications of the above induced by climatic influences or the application of manure—morbid changes of their tissues consequent upon the attacks of insects or disease,—would all prove extensive and interesting fields of inquiry; and it must be left to the writers themselves to select those particular branches of the subject on which they are able to supply the greatest amount of original information.

II. THE CHANNEL ISLANDS.

Twenty-five Sovereigns will be given for the best Report on the Agriculture of the Islands of Jersey, Guernsey, Alderney, and Sark.

The leading physical features of each should be given: character of the Soil; its Agricultural Tenures; size of Farms, as well as various modes of cultivation, describing any peculiarities of local practice; Implements; Live Stock; Dairy Management; Imports and Exports of Farming Produce; Population; reference to former Agricultural Surveys, or notices of a like character; Agricultural changes in progress, or needed.

III. STEAM CULTIVATION.

Twenty-five Sovereigns will be given for the best Account of the application of Steam Power to the cultivation of the Land.

In addition to a general description of the methods now in use, and of such success as has been attained, competitors will be required to give a detailed account of one or more cases where steam power has been employed in the ordinary cultivation of a farm.

IV. TILLAGE A SUBSTITUTE FOR MANURE.

TWENTY SOVEREIGNS will be given for the best Essay on the extent to which tillage operations act as a substitute for manure.

V. MODIFICATIONS OF FOUR-COURSE SYSTEM.

TWENTY SOVEREIGNS will be given for the best Report on the Modifications of the Four-Course Rotation which modern improvements have rendered advisable.

Competitors will be required to describe such deviations from the four-course system as have come within their own experience or observation, pointing out the causes of each change and the advantages obtained thereby. Suggestions of new and untried rotations must be carefully distinguished from the results of past experience.

VI. VARIETIES OF CEREALS FOR HIGH FARMING.

TWENTY SOVEREIGNS will be given for the best Report on the varieties of Wheat, Barley, and Oats most suitable for highly-farmed Land.

Varieties of cereals are frequently confined to very limited districts, and even when they extend over a wider area are generally known by mere local names. Candidates will therefore be expected to send small samples, of six heads, of each of the varieties of cereals recommended, to accompany their respective reports. Care must be taken to tie the small samples together in one bundle, and attach to it a motto paper corresponding to the one enclosed with the report.

VII. FAILURE OF TURNIP CROP.

TWENTY SOVEREIGNS will be given for the best Report on the causes of the increasing difficulties of Turnip Cultivation, and the remedies.

In many turnip-growing districts this crop is found to be less hardy than heretofore, and more liable to the attacks of various diseases. Competitors will be expected to discuss the question whether this is due to the too frequent repetition of this crop, or to any differences in the mode of cultivation or the kinds of manures employed, and to support their opinions as much as possible by facts in preference to abstract reasoning.

VIII. COMPARATIVE COST OF CATTLE FOOD AND MANURE.

Twenty Sovereigns will be given for the best Report on the Comparative Cost of bringing Land into high condition by the purchase of Cattle Food, or the purchase of Manure.

Whatever experience is described in illustration of this subject must be accompanied by full details of price and quantity, both of the manures employed and the crops produced on the one hand, and on the other of the cattle food purchased and consumed, the meat and manure produced, and the field produce obtained by the application of the latter.

IX. ANY OTHER AGRICULTURAL SUBJECT.

Ten Sovereigns will be given for the best Essay on any other agricultural subject.

Reports or Essays competing for the Prizes must be sent to the Secretary of the Society, at 12, *Hanover Square, London, on or before March* 1, 1859. *Contributors of Papers are requested to retain Copies of their Communications, as the Society cannot be responsible for their return.*

Rules, &c.

RULES OF COMPETITION FOR PRIZE ESSAYS.

1. All information contained in Prize Essays shall be founded on experience or observation, and not on simple reference to books or other sources. Competitors are requested to use foolscap or large letter paper, and not to write on both sides of the leaf.

2. Drawings, specimens, or models, drawn or constructed to a stated scale, shall accompany writings requiring them.

3. All competitors shall enclose their names and addresses in a sealed cover, on which only their motto, the subject of their Essay, and the number of that subject in the Prize List of the Society, shall be written.*

4. 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.

5. The Chairman of the Journal Committee shall alone be empowered to open the motto-paper of any Essay not obtaining the Prize, that 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 Essay at the disposal of the Journal Committee.

6. 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 the other Essays will be returned on the application of the writers; but the Society do not make themselves responsible for their loss.

7. The Society are not bound to award a prize unless they consider one of the Essays deserving of it.

8. In all reports of experiments the expenses shall be accurately detailed.

9. The imperial weights and measures only are those by which calculations are to be made.

10. No prize shall be given for any Essay which has been already in print.

11. Prizes may be taken in money or plate, at the option of the successful candidate.

12. All Essays must be addressed to the Secretary, at the house of the Society.

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* Competitors are requested to write their motto on the enclosed paper on which their names are written, as well as on the outside of the envelope.

Members' Privileges of Chemical Analysis.

The Council have fixed the following rates of Charge for Analyses to be made by the Consulting Chemist for 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 Analyses made for Persons commercially engaged in the Manufacture of any Substance for Sale.*

The Address of Professor Voelcker, the Consulting Chemist of the Society, is Cirencester, Gloucestershire, to which he requests that all letters and parcels (postage and carriage paid) should be directed: for the convenience, however, or persons residing in London, parcels sent to the Society's Office, No. 12, Hanover Square, will be forwarded to Cirencester once or twice a week.

By Order of the Council,

JAMES HUDSON, Secretary.

Members' Veterinary Privileges.

I.—Veterinary Inspection.

No. 1. Any member of the Society who may desire a competent professional opinion and special advice in cases of extensive or destructive disease among his stock, and will address a letter to the Secretary, will, by return of post, receive a printed list of queries, to be filled up and returned to him immediately. On the receipt of such returned list, the Secretary will convene the Veterinary Committee forthwith (any two Members of which, with the assistance of the Secretary, will be competent to act); and such Committee will decide on the necessity of despatching Professor Simonds, the Society's Veterinary Inspector, to the spot where disease is said to prevail.

No. 2. The remuneration of such Inspector will be 2*l.* 2*s.* each day as a professional fee, and 1*l.* 1*s.* each day on account of personal expenses; and he will also be allowed to charge the cost of travelling to and from the localities where his services may have been thus required. The fees will be paid by the Society, but the travelling expenses will be a charge against the applicant for professional aid. This charge may, however, be reduced or remitted altogether at the discretion of the Council, on such step being recommended to them under peculiar circumstances by the Veterinary Committee.

No. 3. The Inspector, on his return from visiting the diseased stock, shall report to the Committee, in writing, the results of his observations and proceedings, which report will be laid before the Council.

No. 4. Should 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.—Investigations, Lectures, and Reports.

No. 1. All Members of the Society have the privilege of sending cattle, sheep, and pigs to the Royal Veterinary College, on the same terms as if they were Members of the College.

No. 2. The College have 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 from time to time 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, or at its Annual Meetings in the country, as the Council may decide.

No. 4. The Royal Veterinary College will from time to time furnish to the Council of the Society a detailed Report of the cases of cattle, sheep, and pigs treated in the College.

By Order of the Council,

JAMES HUDSON, Secretary.